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NATURAL HISTORY
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Common and Arctic Tern migration

What it's like to be a bird

Spring migration of long-tailed



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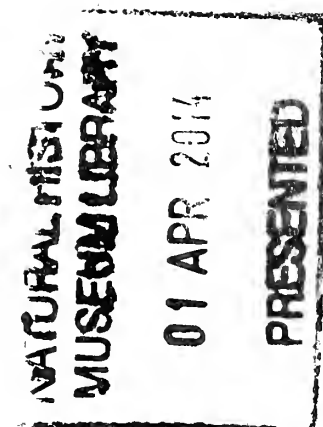
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Front-cover photograph: Male Reed Bunting *Emberiza schoeniclus*, Norfolk, spring 2011.

Richard Chandler



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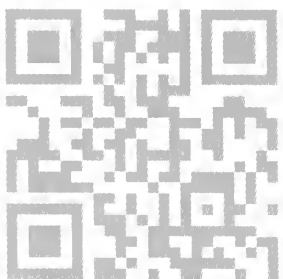
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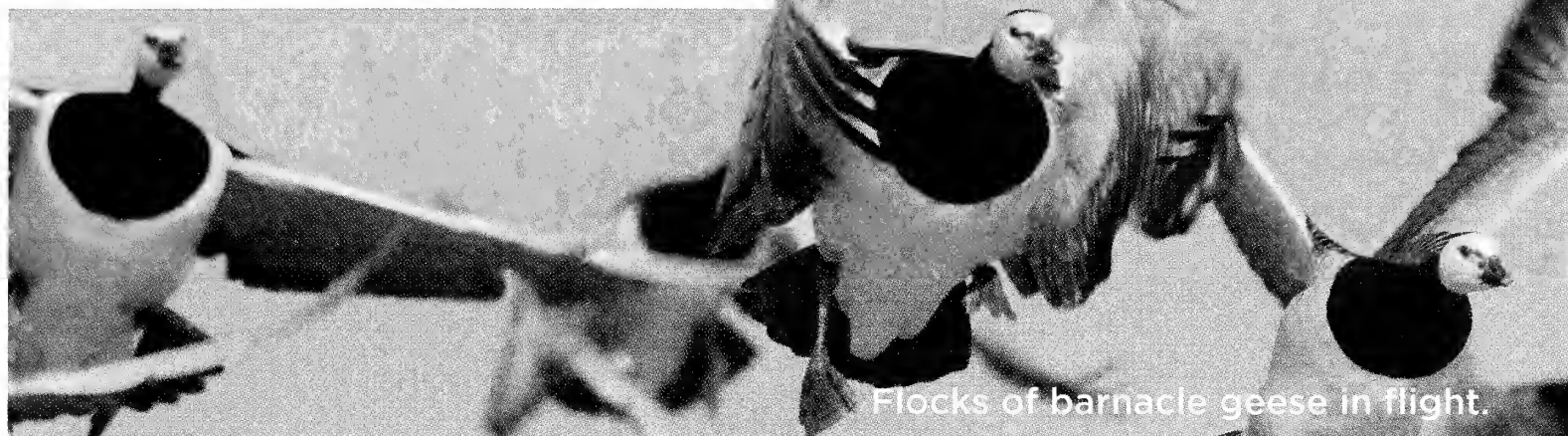
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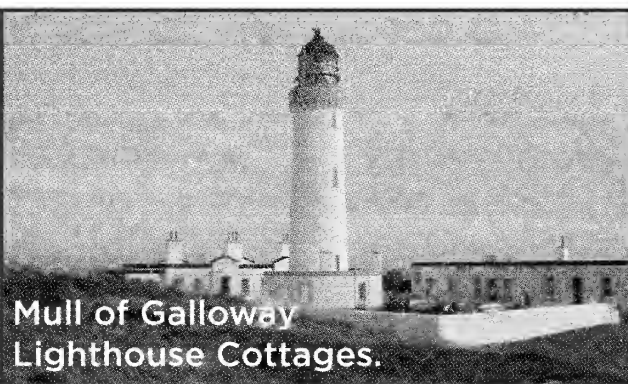
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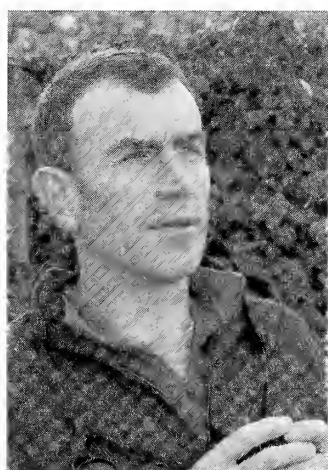
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British Birds

Volume 107 • Number 4 • April 2014

- 188 *BB eye Joe Sultana*
- 191 News and comment *Adrian Pitches*
- 195 The migration of Common and Arctic Terns in southern England
Keith Vinicombe
- 207 What it's like to be a bird *Tim Birkhead*
- 220 Spring migration routes of Long-tailed Skuas around and across
the UK *Russell Wynn, Dan Brown, Gavin Thomas, Chas Holt,*
Sveinn Are Hanssen, Olivier Gilg and Børge Moe
- 229 Notes
- 232 Letters
- 233 Obituary
- 234 Reviews
- 240 Recent reports
- 242 Talking point



Throughout much of Europe, April is the month when spring migration eases into top gear and two papers this month look at the migrations of some of our most impressive seabirds. Whether from coastal watchpoints or at inland waterbodies, most of us have a reasonable chance of encountering Common and/or Arctic Terns on their long-haul spring migration. Long-tailed Skuas are a more exclusive treat, but the record books of 2013 show that there are still discoveries to be made, and that in some years even inland watchers in the right place can be richly rewarded.

Sandwiched between terns and skuas, Tim Birkhead's look at what it's like to be a bird is a wholly different type of article. Pulling together different strands of research on bird behaviour, not all of it modern by any means, allows a fascinating journey through some aspects of the sensory biology of

birds. The asymmetric ear openings of the Great Grey Owl, the theory of a crazy Italian that pigeons can navigate by their sense of smell – and much more... it's a rattling good read.

All of that follows a thought-provoking editorial from Malta's Joe Sultana, a reminder that spring migration has its darker side as well. On 1st April this year, a major new Western Palearctic bird race event takes place in southern Israel in support of BirdLife's work to stop the illegal slaughter of birds on the Eastern Mediterranean Flyway. 'Champions of the Flyway' is a simple, but hopefully winning, formula – and an effective fundraiser. Bird racing is normally a bit too stressful for me, but I'm looking forward to this one as part of the Birding Frontiers team – www.champions-of-the-flyway.com/birding-frontiers If you're able to support the cause (and there's still plenty of time to), that would be much appreciated. Not least by those migrants heading our way.

Roger Riddington



British Birds aims to: ❖ provide an up-to-date magazine for everyone interested in the birds of the Western Palearctic; ❖ publish a range of material on behaviour, conservation, distribution, ecology, identification, movements, status and taxonomy as well as the latest ornithological news and book reviews; ❖ maintain its position as the journal of record; and ❖ interpret scientific research on birds in an easily accessible way.

The saga of spring hunting in Malta

As the chilly winter days become warmer, life and colour begins to emerge in the countryside. Northbound migrants heading for their European breeding quarters herald the arrival of spring. But for thousands of migrating Turtle Doves *Streptopelia turtur* and Common Quails *Coturnix coturnix*, those that managed to survive the ordeal of their autumn migration and a winter sojourn in Africa, the spring journey may abruptly come to an end in Malta.

Malta, like several other Mediterranean countries, has long been regarded as a black spot for migrating birds. William H. Payn, who spent the month of April 1936 in the Maltese Islands to observe migration and collect specimens, was just one of several visitors appalled by the widespread killing of birds: 'During the migration periods every adult male on the island seems to be prowling the fields with gun and capacious game-bag... Every field and fruit-garden has its armed watcher, every small grove of trees in which exhausted migrants might take refuge is beaten through ten and twenty times a day. Nor do the gunners differentiate between species.' From his personal observations bird protection laws were 'observed mainly in the breach' (Payn 1938).

The situation *has* improved. In spite of an uphill struggle, BirdLife Malta celebrated its 50th birthday in 2012 and has good reason to be proud of its achievements. Better bird protection laws, in line with the EU Birds Directive, have been enacted. Law enforcement has improved, while awareness for bird protection among the non-hunting public increased dramatically in recent years. And yet... in spite of all these improvements, illegal bird hunting is still rampant, while legal hunting takes a great toll on birdlife. And on top of this, the hunting of Turtle Doves and Quails in spring is still permitted. What was once a supply of food has become a source of 'entertainment'. It is a long, sad story.

When Malta joined the European Union in 2004 there was great anticipation that spring hunting would stop once and for all,

owing to the fact that Article 7(4) of the Birds Directive specifies that, in the case of migratory species, Member States 'shall see in particular that the species to which hunting regulations apply are not hunted during their period of reproduction or during their return to their rearing grounds.'

During the accession negotiations, Malta requested the inclusion of 16 species in Annex II/2, which lists those species which may be hunted in the Member States in respect of which they are indicated. Turtle Dove and Quail, which were always regarded as the two main gamebirds by the Maltese hunters, figure in this list, which also includes the Skylark *Alauda arvensis* and five species of thrushes. Malta also informed the Commission that it would allow spring hunting of two species, Turtle Dove and Quail, on the basis that these two 'game' species do not appear in sufficient numbers in autumn; clearly a move to appease the hunting lobby, perceived by short-sighted politicians as a force that could potentially bring down a government.

In December 2001, as a prelude to negotiations with the EU, the Maltese National Statistics Office (NSO) carried out a scientific survey to estimate the bird catch during the years 2000 and 2001. From then on hunters had to fill out a *carnet de chasse*, detailing the numbers of birds shot annually, and submit it to the authorities. At that time, the number of licensed hunters stood at 12,345 and their figures of shot birds dropped (table 1); those figures have continued to plummet in more recent years (table 2). From day one, the *carnet de chasse* has provided unreliable figures.

When Malta finally joined the EU, in 2004, the Maltese authorities allowed the hunting of Turtle Doves and Quails for the next three years with hardly any restrictions, in direct contravention of the EU Birds Directive. In 2006, BirdLife Malta complained to the Commission about the spring hunting situation in Malta and in January 2007, together with the RSPB, it presented a 115,000-signature petition to the Maltese Prime Minister urging him to stop illegal

spring hunting. In October 2007, the European Commission sent Malta a final written warning – a Reasoned Opinion – regarding spring hunting. Detecting a glimmer of hope, BirdLife Malta continued its campaign against spring hunting, in spite of threats, physical attacks on birdwatchers, and vandalism of properties and reserves – including the torching of three cars of BirdLife Malta members and the destruction of 3,000 trees of an afforestation project.

During 2008–09, the shooting season in spring remained closed, as a result of an interim order by the European Court of Justice. It was the first time in living memory that the Maltese countryside was brimming with life, with free-flying migrant birds, in the absence of the thousands of gunshots that had polluted every day of previous springs. This happy situation was short-lived, however, in spite of the fact that on 10th September 2009 the European Court of Justice declared that, by authorising the opening of a hunting season for Turtle Doves and Quails during the spring migration period in the years 2004–07, without complying with the conditions laid down in Article 9(1) of the Birds Directive, Malta had failed to fulfil its obligations.

In 69 numbered paragraphs of dense legal text, the Court, before confirming the guilty sentence, stated that the annual reports submitted by Malta showed that hunters were able to capture only an inconsiderable number of birds in the autumn hunting season. Furthermore, it declared that hunting Turtle Doves and Quails during autumn cannot be regarded as a satisfactory alternative to the hunting of these birds in spring. Unfortunately, the European Court of Justice did not refer to the precarious status of these two species in Europe but to their global IUCN status. The hunters claimed victory and since then we have heard *ad nauseam* the assertion that Malta ‘won the case’ for spring hunting. The authorities, for political reasons, succumbed to the hunting lobby and conservation was back to square one.

Since 2010, Malta has allowed a limited

Table 1. Numbers of Turtle Doves *Streptopelia turtur* and Common Quails *Coturnix coturnix* shot in 2000–01 (survey by National Statistics Office) and in 2002–04 (data from hunters). No data from hunters were provided for the years 2000–01.

	year	no. of Turtle Doves	no. of Quails
NSO survey	2000	101,552	49,597
	2001	99,633	44,601
hunters' figures	2002	27,822	16,114
	2003	38,113	19,686
	2004	35,068	17,532

Table 2. Official Government figures of the numbers of hunters and of Turtle Doves *Streptopelia turtur* and Common Quails *Coturnix coturnix* shot during spring in 2011–13. (2011 and 2012 figures from the spring hunting reports of the Malta Environment and Planning Authority; 2013 data from the *Report on the Outcome of the 2013 Spring Hunting Season in Malta* of the Wild Birds Regulation Unit).

year	no. of hunters	no. of Turtle Doves	no. of Quails
2011	5,642	1,842	366
2012	6,113	805	151
2013	9,489	3,175	491

spring hunting season for small numbers of Turtle Doves and Quails, under the pretext that it is carried out under strictly supervised conditions, as demanded by the exceptional circumstance of a derogation to the Birds Directive. BirdLife Malta’s annual reports on Malta’s derogation for spring hunting, which are sent to the European Commission, show otherwise. They demonstrate clearly that, among other shortcomings, the illegal shooting of other protected species increased, and that hunters have been intentionally and grossly under-reporting the numbers of birds shot. Malta’s decision to set a target of 10,000 birds for each species as an adequate autumn hunt (this target being the basis for allowing limited spring hunting) incentivised the hunters to under-report their bags in autumn as well as in spring. Hence, since 2010, over 10,600 licensed hunters in Malta continue to declare catching on average less than one Turtle Dove and one Quail during the autumn hunting season, compared with the thousands declared and estimated in previous years (table 1).

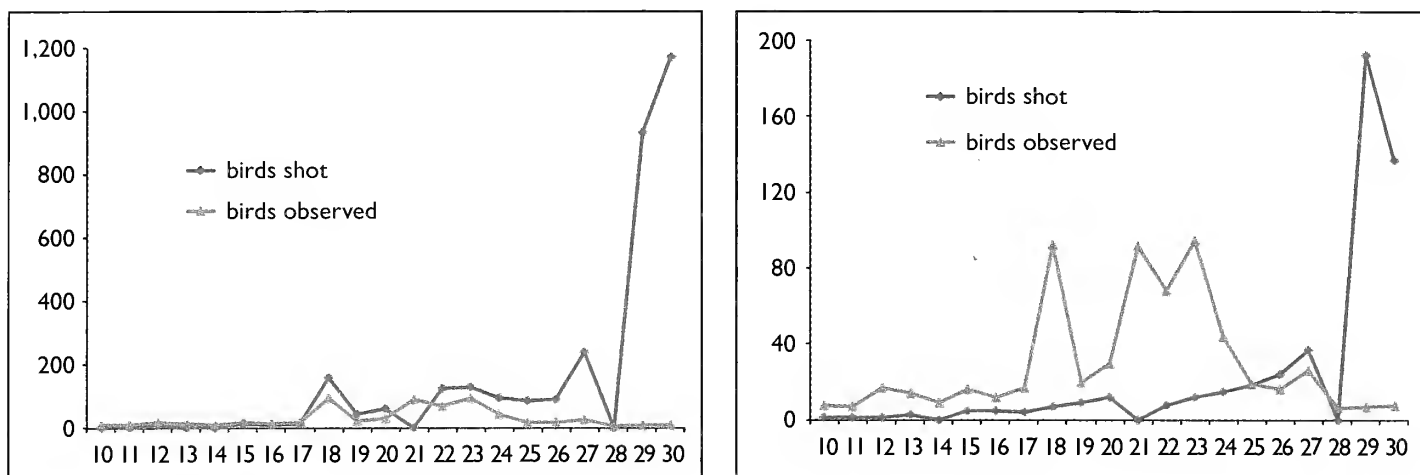


Fig. 1. Official figures of Turtle Doves *Streptopelia turtur* (left) and Common Quails *Coturnix coturnix* (right), showing the birds reported shot in spring (red) compared with field totals counted (blue) each day during the spring hunting period, 10th–30th April, in 2013. Note that no shooting is permitted on Sundays, so the total shot on 14th, 21st and 28th is zero. Field totals from environmental consultancy work commissioned by the Maltese Government.

In March 2013, a new Government was elected and, although the limits of the national spring quotas (11,000 Turtle Doves and 5,000 Quails) remained unchanged, the season was extended, to cover the period 10th–30th April. What's more, the spring licence fee was waived and the number of licensed spring hunters increased from 5,642 (in 2011) to 9,489. This meant that, in theory, each hunter was not allowed to take more than one Turtle Dove, while 5,000 Quails had to be shared among more than 9,000 hunters. Hunters were requested to send a text message to the Malta Environment and Planning Authority (MEPA) each time they shot a bird in order to register it.

Fig. 1 comes from an official government document, *Report on the Outcome of the 2013*

Spring Hunting Season in Malta, compiled in May 2013. It clearly illustrates that the numbers of Turtle Doves and Quails declared by the hunters are totally unreliable and nothing but a sham. Most hunters do not send a text message when they shoot a Turtle Dove or a Quail, they send one or two on the last day or two of the season. The official figures of Turtle Doves and Quails shot in spring 2013 were 3,175 and 491 respectively (66% and 67% respectively of the totals were shot on 29th and 30th). It would be closer to reality if two zeros were added to each total.

According to the *Guide to Sustainable Hunting Under the Birds Directive*, both Turtle Dove and Quail are listed as huntable species with unfavourable conservation status. How is it possible that the EU Com-

mission can continue to turn a blind eye to these facts and continue to be taken for a ride, when European species of conservation concern are shot in spring under the guise of sustainable hunting? Those of us who hail from the Mediterranean have learnt through bitter experience that sustainable hunting of migrant birds is nothing but a myth.

Reference

Payn, W. H. 1938. Some notes on the spring migration in Malta and Gozo. *Ibis* 80 (1): 102–110.

Joe Sultana

Lars Soerink/BirdLife Malta



86. Four Common Quails *Coturnix coturnix* shot by a single hunter in Malta, 21st April 2013. The hunter was reported to the police by BirdLife Malta, since the quota per hunter per season is less than one Quail.

What do you think? Join the debate at www.britishbirds.co.uk/category/editorials

News and comment

Compiled by Adrian Pitches

Opinions expressed in this feature are not necessarily those of *British Birds*

Vulture-killing drug now available in Europe

The powerful anti-inflammatory drug that has wiped out vulture populations across the Indian subcontinent has now been made available in Europe, threatening a repeat of the ecological disaster that took place in Asia. Despite the fact that safe alternatives are readily available, diclofenac has been authorised for use on domestic animals in Spain, where 80% of European vultures live, and in Italy.

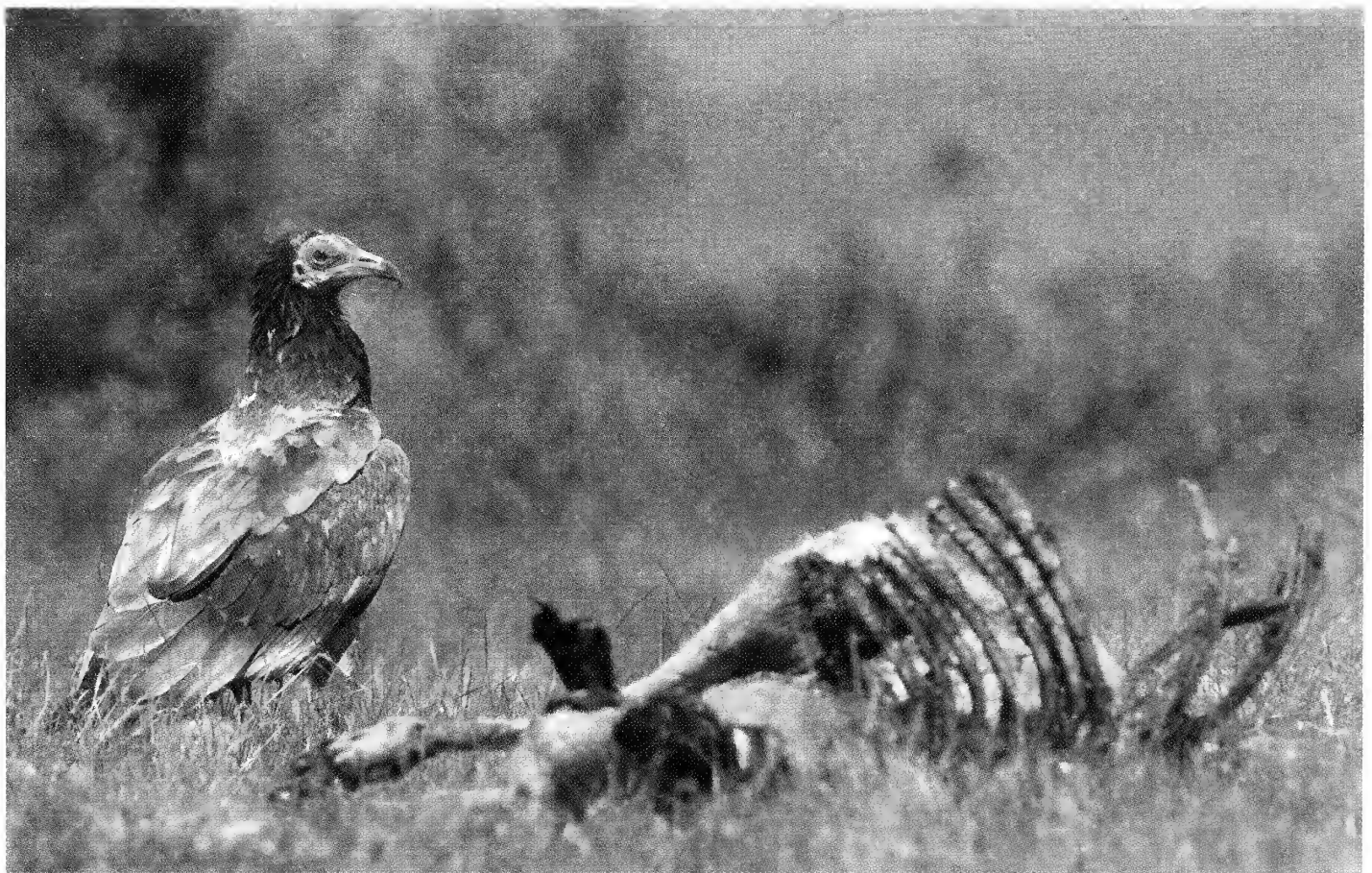
Vultures have long suffered from unfavourable public opinion in Europe, but as species that are built to do the dirty work of ecological recycling, they are essential to the health and wellbeing of ecosystems. Europe's four species of vulture continue to face threats to their survival. Egyptian Vulture *Neophron percnopterus* is currently listed as Endangered while Eurasian Black Vulture *Aegypius monachus* is listed as Near Threatened. Fortunately, thanks to decades of conservation efforts and millions of euros invested, vulture populations are currently in recovery. The introduction of diclofenac will put all that effort and investment in jeopardy.

In India, Pakistan and Nepal, diclofenac was

used regularly in the 1990s to treat cattle. When the animals died, diclofenac remained in the carcasses; when those carcasses were stripped by vultures, the birds suffered acute kidney failure and died almost immediately. Within a decade, the vulture populations in these countries had declined by 99%, bringing some of the most common and iconic large birds of the Indian subcontinent to the verge of extinction: Indian White-backed Vulture *Gyps bengalensis* numbers fell by 99.9% and Indian *G. indicus* and Slender-billed *G. tenuirostris* numbers by 97%.

In turn, this led to serious human health consequences as the availability of unconsumed carrion led to an increase in stray dogs and the spread of diseases such as rabies. Thanks to a joint campaign effort by the RSPB and Saving Asia's Vultures from Extinction (SAVE), diclofenac was banned in the subcontinent in 2006 and the first signs of recovery have been noted in the Indian vulture population (see below).

The EU and its Member States have a legal obligation to conserve vultures under the EU Birds Directive. An immediate ban on veterinary



Roger Tidman/FLPA

87. Immature Egyptian Vulture *Neophron percnopterus* at a carcass in Castilla y León, May 2002. The use of diclofenac for treatment of domestic animals in Spain could spell disaster for this and other vultures in Europe's most important country for these birds.

diclofenac is needed to protect our vultures from the fate of their Asian cousins; this would also send a crucial signal to African countries about the dangers of diclofenac, which is already affecting the highly endangered populations of African vultures.

A petition by British birder John Gilbody to cancel the diclofenac licence has been started. Please sign it at www.change.org/petitions/european-union-diclofenac-the-vulture-killing-drug-is-now-available-on-eu-market

Asian vulture releases to start in 2016

The Saving Asia's Vultures from Extinction (SAVE) programme has told BBC News that it plans to release its first captive-bred birds in 2016: up to 25 birds will be released into a 30,000-km² drug-free 'safe zone'.

Three captive-breeding centres were established in 2004 for the three Critically Endangered species as the last-ditch means of saving Asia's vultures. A decade later, the first releases are now planned.

Chris Bowden, RSPB International Species Recovery Officer and SAVE programme manager, told BBC News: 'This year we are likely to break

the 100 figure for the number of fledglings produced via the captive-breeding programme. We've bred all three species and these species had never been bred before so I think we can be very pleased about the way it is going.

'I am optimistic that, within my lifetime, we really can get vultures back to the level where they are performing the environmental function that the populations used to perform. A few years ago, I would not have said that. But it is not going to be easy; there is still a lot to do.'

And good news for Egyptian Vultures in Sudan

The notorious power line from Port Sudan to the Red Sea coast, which is estimated to have electrocuted hundreds and perhaps thousands of migrant Egyptian Vultures since its construction in the 1950s, has been switched off. This decisive action by the Sudanese Government and power company officials follows years of work by BSPB (BirdLife in Bulgaria) and the Sudanese Wildlife Society (SWS).

The decision to decommission and replace the 'killer line' followed a BirdLife Migratory Soaring Birds presentation to senior government and power company representatives in March 2013. By September, work had begun on a new, fully insulated distribution line running parallel to the existing line. And work is already complete and the old line switched off. Would such a rapid response happen in a European country?

First Irish-bred White-tailed Eagle found shot

Ongoing raptor persecution is a sadly familiar story in the UK, 60 years after it was made illegal, but it's rearing its ugly head in Ireland too. One of the first young White-tailed Eagles *Haliaeetus albicilla* to fledge in the Irish reintroduction scheme has been found dead with shotgun injuries. It was found by a member of the public near Ballinderry, North Tipperary, on the north-east shore of Lough Derg.

Subsequent post-mortem examination by pathologists at the Regional Veterinary Laboratory at Knockalisheen, in Co. Limerick, showed that the young male eagle had been shot, the body holding some 45–50 shotgun pellets. The impact of the shooting broke one of its legs and wings but the bird survived some weeks after the shooting before dying. The horrific nature of the bird's shooting and ultimate death has shocked all those involved in the reintroduction project.

Jimmy Deenihan TD, Minister for Arts, Heritage and the Gaeltacht, said: 'So much work has gone into reintroducing this species here, and there has been wonderful co-operation by many different groups to achieve successful breeding. To have all this undone is a significant blow. Eagles are protected by law. I would urge anyone with information to contact An Garda Síochána or my Department's staff in the area.'

'Finding one of the first two young White-tailed Eagles to fly from a nest in Ireland shot dead is heartbreaking,' added Dr Allan Mee, Reintroduction Project Manager. 'It is absolutely incomprehensible that someone would shoot one of these magnificent birds – but even more shocking is that one of the first two Irish-bred eagles has been shot only seven months after leaving the nest.'

BB grant to the Hawk & Owl Trust

A BB grant of £1,000 has been awarded to the Hawk & Owl Trust for management work at their Sculthorpe Moor reserve in the Wensum Valley, Norfolk. The reserve is run by the Trust, supported primarily by local volunteers and is open to everyone. The Trust is in the process of restoring a sizeable reedbed on the reserve, which already supports breeding Marsh Harriers *Circus aeruginosus*

and other important wetland species. They hope to raise £100,000 over the next decade – partly to open up the reedbed and create more fringe habitat, and partly to improve the visitor experience, with boardwalks and a tower hide (visit <http://hawkandowl.org/sculthorpe/about-sculthorpe>).

Plight of the Kittiwake is the focus of the Fair

At this year's Scottish Birdfair (at Hopetoun House near Edinburgh, on 11th–12th May), the Kittiwake *Rissa tridactyla* is the species in the spotlight. Funds raised at the fair will go to help Kittiwakes and other threatened Scottish birds. Tickets cost £12/£10, under 16s go free; visit www.scottishbirdfair.org.uk or call 0131 317 4100 to find out more.

It is well established that terrestrial wildlife is responding to climate change, with ongoing shifts in range and the timing of life-cycles evident. In the marine environment, it is increasingly clear that dramatic and fundamental changes are already underway.

Sea-surface temperatures are rising and, since the mid 1980s, the winter 10°C sea-surface isotherm, traditionally situated around the British coastline, has been moving northwards at a rate of 22 km per year. Simultaneously, the breeding populations of many seabirds in the North Sea have been in sharp decline. The Kittiwake is among the most seriously affected species. UK breeding numbers have fallen by over 60% since 1986 with some places, notably the Northern Isles, experiencing severe losses. Numbers breeding at five colonies on Orkney fell from over 50,000 in 1969 to just 3,217 in 2013, while on Fair Isle the population has declined from 18,159 pairs in 1992 to just 711 pairs in 2013 and

losses of similar magnitude are evident at major colonies in Shetland. These losses do not appear to be offset by increases farther north. In Norway, declines are evident at monitored colonies, and anecdotal evidence from Iceland and the Faroes indicates a similar situation.

Low breeding success and low adult survival are the drivers of the declines, and research – including the long-term studies on the Isle of May



Mike Lane

88. Kittiwake *Rissa tridactyla*, Dunbar, Lothian, June 2005.

led by Sarah Wanless, Mike Harris and colleagues from CEH – indicates that the cause centres on lack of availability and low quality of prey fish.

In order to thrive, large seabird colonies need access to abundant, nutritious, shoaling fish. Since recording began, the Lesser Sandeel *Ammodytes marinus* – oily, highly nutritious and once spectacularly numerous – has been the key prey species for Kittiwakes and an array of other marine predators around British coasts. Sandeel abundance has probably always fluctuated from year to year to some extent but, particularly since the year 2000, periods of poor prey availability (and hence low breeding success) have become unusually deep and long-lasting. Coupled with decreased adult survival, the effect on Kittiwakes and several other seabirds has been devastating.

The warming of the sea surface and associated changes in ocean currents appear to be implicated. In marine systems, the plants that capture the sun's energy and the herbivores that graze on them – in other words, the ecological basis of marine food chains – are the plankton species. Their distribution, abundance, and the timing of their life-cycles are determined by oceanic conditions. The biomass of the plankton species that sandeels feed on has declined around our coasts by almost three-quarters since the 1960s. Studies show that the warming of the North Sea has disrupted the breeding synchrony and timing of several

important plant and herbivore plankton groups. One particular type of cold-water zooplankton herbivore, a copepod called *Calanus finmarchicus*, was once dominant but is now being replaced by a warmer-water relative, *C. helgolandicus*. These *Calanus* copepods make up around a third of the sandeel diet. Not only has the warm-water species replaced its cold-water cousin at much lower abundance, but the former is less nutritious, with a lower fat content. Such changes appear to be a key factor in driving down sandeel abundance, and the consequent seabird declines.

There is still much to learn about these processes. Scientists, including those at RSPB Scotland, are working to understand effects of changes in the marine environment, for example using tracking devices to investigate how at-sea behaviour is changing at specific foraging locations, and relating this to breeding productivity. The North Sea is changing, and the food web that Kittiwakes rely on seems to be changing with it. We don't yet understand what can be done in the face of these huge challenges but the RSPB and others are committed to working towards effective responses that will make Kittiwakes and our other seabirds as resilient as possible to the profound changes taking place around our coasts.

(Contributed by Philip Taylor, Paul Walton and Matthew Carroll)

New single-species bird family identified

Ongoing phylogenetic work by Per Alström, Urban Olsson and their co-workers on the evolutionary relationships of the Passeriformes has produced an unexpected new finding. Their research (see *Biology Letters* Vol. 10, No. 3 <http://rsbl.royalsocietypublishing.org/content/10/3/20131067.short?rss=1>) suggests that the Spotted Wren-babbler *Spelaeornis formosus*, which ranges from northeast India across to China and south to Vietnam, is sufficiently distinct from other wren-babblers that it merits inclusion in its own family. The authors state: 'We conclude that the Spotted Wren-babbler represents a relict basal lineage within Passerida with no close extant relatives, and we support the already used name *Elachura formosa* and propose the new family name Elachuridae for this single species.' For those world birders aiming to tick off all the bird families of the world, there's another one to catch up with!

BB grants to young birdwatchers

Following the success of last year's scheme, BB is once again awarding grants of up to £250 to young birdwatchers in the UK. The BB grant aid will help with the costs of a stay at a bird observatory on the British coast and/or expenses incurred learning to be a bird ringer.

Encouraging young people to pursue their interest in birds and birdwatching is crucial; they are the next generation of conservationists. For an application form, send an e-mail to adrianpitches@blueyonder.co.uk with the applicant's name, age, where they live and a brief outline of their need for grant aid.

Correction

James Cracknell has asked us to point out that the UKBirdnet e-mail discussion group (*Brit. Birds* 107: 120) was hosted by Birkbeck College at the University of London – not University College, London. We apologise for the error.

For extended versions of many of the stories featured here, and much more, visit our website www.britishbirds.co.uk

The migration of Common and Arctic Terns in southern England

Keith Vinicombe

Abstract Counts of Common *Sterna hirundo* and Arctic Terns *S. paradisaea* at Chew Valley Lake, Avon, are analysed over a 36-year period. These data are compared with counts from seawatching headlands on the south coast of England – at Portland and Dungeness – and also on the north coast of France, at Cap Griz Nez. This enables a comparison of the migration patterns of the two species and clarifies the likelihood of encountering either in southern England. Their identification is also revisited and the reliability of data from some areas is queried.



Rich Johnson

Common and Arctic Terns

A number of seminal papers in the 1960s and 1970s clarified the identification of Common *Sterna hirundo* and Arctic Terns *S. paradisaea*, particularly Grant & Scott (1969) and Hume & Grant (1974). The criteria put forward have since been incorporated into the better field guides and this in turn has led to greater confidence in the separation of these two superficially similar species. Despite this, it seems that little has been written about the *likelihood* of

either species being encountered at any given place at any particular time. In Britain, most observers are aware that Arctic Terns breed almost exclusively in northern coastal areas and that Common Terns are more widespread, and breed quite commonly in the south, including at inland sites such as reservoirs and gravel-pits. However, information on the distribution and relative abundance of the two species on spring and autumn migration seems hard to come by, the true status of



89. Adult Arctic Tern *Sterna paradisaea*, Apex Park, Somerset, April 2013.

the two species being obscured by identification problems. Despite the identification progress described above, many observers continue to lump them as 'Commic Terns' and this somehow perpetuates a widely held misconception that there is an equal chance of encountering either species. Conversely, at the opposite end of the spectrum, there may now be an increasing level of overconfidence at some sites, particularly in terms of distant flocks speeding past coastal migration points.

Chew Valley Lake

This paper is based mainly on counts made on an ad hoc basis at Chew Valley Lake, Avon, during 2,207 visits between April and November from 1978 to 2013. I have used only my own data because (a) I feel confident that the vast majority of my identifications have been correct and (b) it is impossible to judge the accuracy of other observers' records. Most terns at the lake move on after a single day but, inevitably, a few remain for several days. The figures used are based on bird-days, no attempt being made to second guess whether any particular individual(s) stayed for more than a single day.

Chew Valley Lake is in many ways an ideal site for an analysis of Common and Arctic Tern migration. It is a 500-ha reservoir, roughly 4 km by 3 km, situated 25 km east of the Bristol Channel and some 75 km north of the English Channel. Although reasonably

close to the sea, it is also relatively isolated. Given its size and position, it regularly receives significant numbers of Common and Arctic Terns, both as cross-country migrants and as storm-driven birds in the wake of Atlantic depressions. There are two other reasons why the lake is ideal for the analysis of the species' occurrence patterns. Firstly, unlike at many coastal sites, the vast majority of terns can be identified to species level unequivocally – even distant individuals eventually come close enough to be identified. Secondly, there are no breeding colonies of either species nearby, so it can be certain that any tern seen at the lake is a genuine migrant. In other words, the data are not 'polluted' by nearby breeding birds on feeding trips. The nearest breeding site for Common Terns is 45 km to the north at Slimbridge, Gloucestershire (currently 5–6 pairs; Martin McGill *in litt.*), but there is nothing to suggest that those birds commute to Chew. Single pairs of Common Terns have also bred 21 km to the south on the Avalon Marshes in Somerset, but were successful only in 2007 and probably 2008, with attempted breeding in 2005 (Brian Gibbs *in litt.*). Again, there is nothing to suggest that these birds used Chew as a feeding site.

Annual totals

A grand total of 3,568 Common or Arctic Terns was recorded during the study period, of

which 98.4% were identified to species level: 2,942 Commons and 570 Arctics. Annual totals of Common Terns varied from a meagre 16 in 1978 to 245 in 1992, with an average of 82. Annual totals of Arctics varied from just two in both 2000 and 2004 to an exceptional 104 in 1982 (the next highest was 59 in 2013), with an average of 14.

Relative abundance

The overall ratio of Commons to Arctics was 5.2:1, but there were distinct seasonal differences (see table 1). In April and May, Commons outnumbered Arctics by up to 4:1, but in August, as the autumn Common Tern migration built up to its peak, the ratio rose to more than 12:1. In September, as Common Terns declined and Arctic Terns started to occur in higher numbers, the ratio fell to about 5:1 and, by October and November, Arctics outnumbered Commons.

Seasonal totals

Figs. 1 and 2 show the temporal distribution patterns of the two species based on ten-day periods (for months with 31 days, the 31st was included in the third period). Most readily apparent is the large number of Common Terns compared with Arctics, but also striking is the protracted nature of both species' migrations. Both were commoner in autumn (July to November) than in spring (April to June), by a ratio of 3:1 for Common and nearly 2:1 for Arctic.

Spring

The earliest spring Common Tern was recorded on 4th April (1992), the earliest Arctic Tern on 12th April (1996). Common Terns increased rapidly during April to a

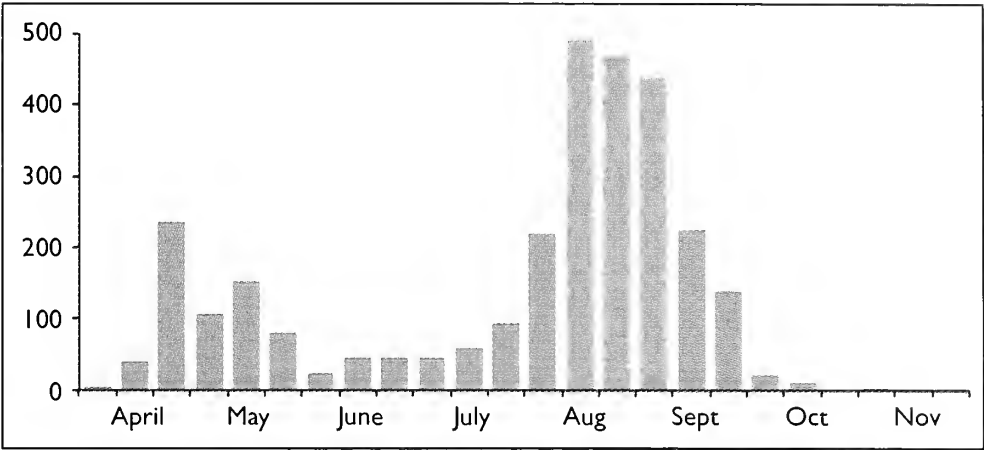


Fig. 1. Numbers of Common Terns *Sterna hirundo* at Chew Valley Lake, Avon, in ten-day periods, April–November 1978–2013. Counts are in bird-days.

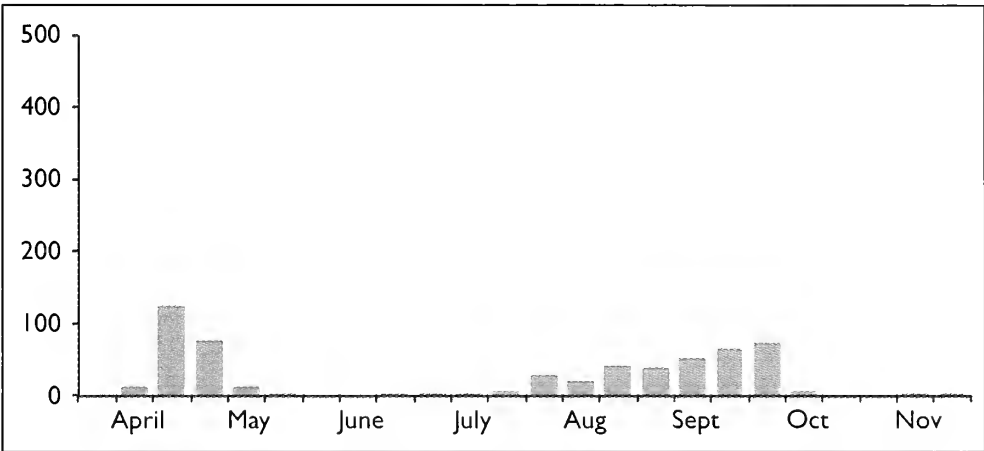


Fig. 2. Numbers of Arctic Terns *Sterna paradisaea* at Chew Valley Lake, Avon, in ten-day periods, April–November 1978–2013. Counts are in bird-days.

Table 1. Ratios of Common Terns to Arctic Terns at Chew Valley Lake between April and November, 1978–2013.							
A	M	J	J	A	S	O	N
2.0:1	3.9:1	28.8:1	16.3:1	12.9:1	5.2:1	0.4:1	0.17:1

clear peak in the last ten days of the month. Numbers remained high throughout May, with a secondary peak in mid-month, before dropping markedly in the first week of June. Arctic Terns had a similar pattern in that they increased rapidly to a spring peak in late April. Numbers remained high in the first ten days of May but thereafter fell sharply, with only 13 birds recorded in the last two ten-day periods of May combined. Their passage was clearly both smaller and more concentrated.

Summer

The last spring Arctic was recorded on 27th May (1996) but Commons continued to occur throughout June, with 46 and 45 in the second and third ten-day periods respectively. It was, therefore, impossible to determine when their spring migration ended and autumn migration began. The June records



90. Adult Common Tern *Sterna hirundo*, Apex Park, Somerset, April 2013.

of both species were interesting in that seven of the Commons were tentatively aged as second-summers, suggesting that many of the June records related to immatures or non-breeding adults. Similarly, all four late-June Arctics were also immatures, three being aged as first-summers and one (tentatively) as a second-summer. Two presumed first-summers on 22nd June 1990 occurred only five days after an unusual record of a summer-plumaged Grey Phalarope *Phalaropus fulicarius*, perhaps suggesting a more general displacement from the North Atlantic. Common Terns were seen displaying on five occasions between late June and 3rd August. The late dates for this behaviour also suggest that these midsummer birds were young adults or perhaps failed breeders from elsewhere. Nonetheless, there has never been a serious breeding attempt at the lake, presumably a consequence of a lack of suitable nesting sites.

Autumn

Numbers of Common Terns in the first ten days of July were similar to those in mid and late June. By the middle of July, however, there was a slight but perceptible increase and this accelerated to the end of the month, indicating that autumn migration was underway. The first record of a juvenile occurred on 12th July (1992). Numbers increased rapidly in the first ten days of August, rising further to a peak in the middle of August. Thereafter, numbers began to decline, although they remained high throughout late August and

early September, followed by a steep decline to the end of September. Few remained into October and the last records were on 19th, with the exception of a late juvenile on 1st November (1981). The pattern for Arctic Tern was markedly different. As with the Commons, the first signs of autumn migration began in mid July, although the numbers to the end of that month were very small (but in 2011 included an adult accompanying a begging juvenile on the early date of 29th July). Numbers showed a marked upturn in early August and increased slowly and steadily throughout late August and September to early October. Arctic Terns were thus characterised by a small but protracted autumn migration that lacked a clear peak. It should be mentioned, however, that the early October maximum was almost entirely due to a significant influx of 25 (24 juveniles) on 28th September 1982, a result of strong southwesterly gales. Unusually, that group remained until 3rd October (with the last six on 5th), pushing the overall autumn peak into early October; otherwise, it would have fallen at the end of September. As with the Common Terns, the last birds (all juveniles) were seen in mid October, the latest being on 20th (2001), although in 1996 a single juvenile was present on 8th–21st November, with a second joining it on 16th–21st, three weeks later than the latest Common.

Age ratios in autumn

Because of the greater numbers of Common Terns, it was difficult to assess the ratios of

Table 2. The percentage of Arctic Terns aged as juveniles at Chew Valley Lake between July and November, 1978–2013.

J	A	S	O	N
8.3	48.4	85.5	97.5	100

adults to juveniles accurately, particularly in the larger flocks, and this was made more difficult by the presence of some adult Commons that were already acquiring winter plumage. I did, however, record the age ratios of Arctic Terns in autumn, partly because the numbers of birds were smaller and also because the juveniles are much easier to pick out. Only a single juvenile was seen in July (see above) but the proportion gradually increased during the autumn so that, from September onwards, the great majority were juveniles (table 2).

Factors affecting tern migration at Chew

The weather

It is clear that both species deliberately migrate overland but there is no doubt that the numbers occurring at Chew are strongly influenced by the weather. I made no attempt to correlate records with day-to-day weather patterns but, from personal experience, I know that many terns appear during inclement weather, with heavy rain often causing significant arrivals. Downpours clearly grounded birds that, in fine weather, would have continued overhead undetected. Autumn birds flying into passing Atlantic weather fronts or migrating in ‘anticyclonic gloom’ may also be grounded, but both of these conditions probably also render the lake invisible to birds passing at any distance. Fine, anticyclonic conditions are probably the worst for arrivals of terns at Chew, the birds no doubt continuing high overhead (such conditions

are also notoriously poor for overland wader migration). The main difference between the two species is that Arctic Terns seem much more prone to occur after gales. The storm-driven influx in late September 1982 has already been mentioned, but the two largest influxes in spring were also associated with adverse weather. Some 38 on 4th May 1991 occurred during a spell of cold northerly winds and coincided with the appearance of an adult Long-tailed Skua *Stercorarius longicaudus* the following day at nearby Severn Beach (*Avon Bird Report 1991*) suggesting displacement from the North Atlantic (see the Grey Phalarope in 1990 mentioned above). The same period also saw a large movement of Arctic Terns through the Midlands, with 300 reported at Pitsford Reservoir, Northamptonshire, on 30th April 1991, and 280 at Eyebrook Reservoir, Leicestershire, on 5th May (Allsopp & Nightingale 1991). Similarly, an influx of 23 on 30th April 2002 coincided with three days of stormy weather and 24 mm of rain (Bland 2003).

Phases of the moon

It is well known that migrating wildfowl and waders are heavily influenced by the phases of the moon, the heaviest migration occurring around the full moon (often immediately before it). The theory is that waterbirds benefit from the light of the moon, which helps them to locate lakes and marshes that are more visible in such conditions. In my experience, tern migration at Chew also tends to peak around the full moon. To test



Rich Andrews

91. Adult Common Tern *Sterna hirundo*, Chew Valley Lake, Avon, August 2008.



92. Juvenile Common Tern *Sterna hirundo*, Upper Bittell Reservoir, Worcestershire, September 2007.

that theory, I plotted all the Chew tern records against the moon phases, dividing each month into four quarters around the full and new moon. The results showed that 57% of the Common Terns migrated in the two-week period either side of the full moon, 43% in the two-week period either side of the new moon. The pattern was stronger for Arctic Terns: 70% and 30% respectively. This implies that a significant proportion of their overland migration is nocturnal, at least in its initial stages. Together with the effect of weather, the ideal scenario for a good inland tern passage would be heavy downpours (or, in the case of Arctic Terns, gales) either side of a full moon.

The status of Arctic Terns in the English Channel

The foregoing analysis relates to just one inland reservoir in southwest England. Is there any evidence to suggest that the patterns at Chew are typical?

Portland

Every year I spend several days at Portland Bird Observatory in Dorset, most visits being in late April or early May. Projecting some 7 km into the English Channel, it is a well-known seawatching site. In favourable conditions, a heavy passage of 'Commic Terns' is often recorded, particularly in spring. I have analysed my records from annual visits

between April and October during the 35-year period 1978–2012 (159 days of observation). As with any coastal migration spot, the problem with analysing tern records at Portland is that distant, fast-moving birds are unidentifiable and the status of migrant terns is also clouded by the presence of breeding Common Terns from local colonies, in this case from Chesil Beach, Portland Harbour and Weymouth. Consequently, my casual records can be taken only as a crude impression of the true situation. Coinciding with a heavy tern passage at Portland is very much a hit-and-miss affair but, during the period concerned, I recorded 549 Common Terns and 419 unidentified Common/Arctic Terns, the latter inevitably relating to the more distant individuals. However, what is particularly interesting is that, during that 35-year period, I saw only *three* certain Arctic Terns: two juveniles close inshore on 27th August 1988 and a particularly obvious adult tagged onto a Common Tern flock on 12th May 2001. Thus, from my records, Common Terns outnumbered Arctics by 183:1. Remarkably, in the same period I saw more Roseate Terns *S. dougallii* (nine sightings involving six individuals).

Dungeness

Located at the narrowest point of the English Channel, Dungeness, in Kent, is *the* prime site for studying the migration of Common

and Arctic Terns on the south coast. David Walker, warden of Dungeness Bird Observatory, kindly sent me extracts for both species from the *Dungeness Bird Report* for the five years 2007–11. The figures published list the highest counts. Since these are not directly comparable with the Chew data, I attempted to obtain a rough comparative figure of abundance for the two species simply by comparing the largest annual spring counts. The first Common Tern recorded was on 26th March 2011 (with the exception of a very early first-winter from 27th February to 1st March 2010); the earliest Arctic was on 10th April (in both 2007 and 2009). The largest movements of Common Terns occurred between 13th April and 29th May, the highest count being 3,750 flying east on 14th May 2010. The largest counts of Arctic Terns (50+) occurred between 12th April and 15th May, with the highest count being 280 flying east on 30th April 2007. As at Chew, this suggests that the Arctic Tern passage is concentrated mainly in the last two weeks of April and the first two weeks of May, whereas Commons continued to move in numbers until the end of May. The peak figures suggest that, in spring, Common Terns at Dungeness outnumber Arctic Terns by 19:1, with extremes of 4:1 in 2007 and 36:1 in 2010. Although not on the same level as my 183:1 ratio from Portland, the figures nevertheless indicate that Arctic Tern is much the rarer species.

Records for the ten years 2003–12 (from the Dungeness Bird Observatory website) indicate that small numbers of Arctic Terns continue to occur in June, increasing in July; interestingly, as at Chew, several of the mid-

summer birds were aged as first-summerers. Numbers then rose sharply in August before reaching a clear peak in September (the highest count being 80 flying west on 23rd September 2007). Significant numbers sometimes remained into October, often involving lingering juveniles feeding on ‘The Patch’ (the warm-water outflow from the nuclear power station), with the final records (three) as late as 10th November. These reports indicate a midsummer and autumn occurrence pattern very similar to that found at Chew (see fig. 3).

Cap Gris Nez

I also compared the Chew data with records from Cap Gris Nez in northern France. A similar tern migration to that at Dungeness is apparent on the opposite side of the Channel, but it is far larger. The grand totals of bird-days for the five-year period 2007–11 were 229,448 Commons and 2,972 Arctics, with 97.5% of the birds identified to species level. Counts of over 8,000 Common Terns in a day were recorded both in spring and in autumn (respective maxima of 8,244 on 24th April 2010, and of 8,180 on 5th September 2008, with 8,500 the following day). Figs. 4 and 5 were compiled using information obtained from www.trektellen.nl. The overall ratio of Commons to Arctics was 77:1 but, as at Chew, there were distinct seasonal variations. The ratios were highest in July and August and lowest in October; only in November were there more Arctics than Commons (table 3).

The patterns for both species at Cap Griz Nez were similar to those found at Chew. Autumn totals of Common Terns outnumbered spring totals (by a

factor of 1.6:1) and spring migration showed a large peak from mid April to mid May and again in late August and early September. In spring, Arctic Tern migration was smaller and more concentrated, with a clear peak in the last ten days of April. In autumn, there was a protracted migration from late July to early

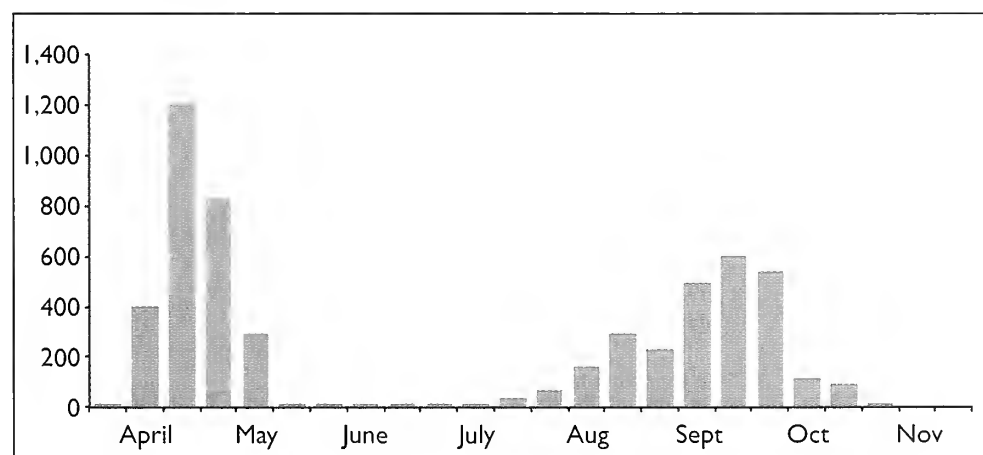


Fig. 3. Numbers of Arctic Terns *Sterna paradisaea* at Dungeness, Kent, in ten-day periods, April–November 2003–12. Counts are in bird-days.

November, most in mid and late September but lacking a clear peak. There were only seven counts of more than 100: five in spring, between 22nd April and 1st May (with a maximum of 285 on 23rd April 2007) and two during 18th–22nd September (with a maximum of 127 on 22nd September 2007). Unlike at Chew, more Arctics were identified in spring than in autumn, with a ratio of 1.7:1

As at Chew, there was a distinct correlation between Common Tern movements and phases of the moon. Of 40 counts of 1,000–3,000 birds, 63% of counts occurred in the two-week period around the full moon. Of 15 counts of more than 3,000, 80% of counts were in that same two-week period around the full moon. In contrast, however, of seven counts of Arctic Terns over 100, only one occurred within a week of the full moon.

Annual migration of Common and Arctic Terns

Ringling recoveries indicate that Common Terns breeding in western Europe winter principally along the coast of West Africa, mostly from Mauritania to Nigeria, with a few travelling farther south to Angola and South Africa (www.bto.org/volunteer-surveys/ringing/publications/online-ringing-reports). Their migration appears to follow the coasts of southwest Europe and West Africa. The Arctic Tern is renowned for its annual migration, travelling up to 90,000 km a year back and forth between Arctic breeding grounds and Antarctic wintering grounds, the equivalent of three trips to the moon and back during an average lifetime (Fijn *et al.* 2013). Egevang *et al.* (2010) clarified the route taken by birds nesting in northeast Greenland and western Iceland by

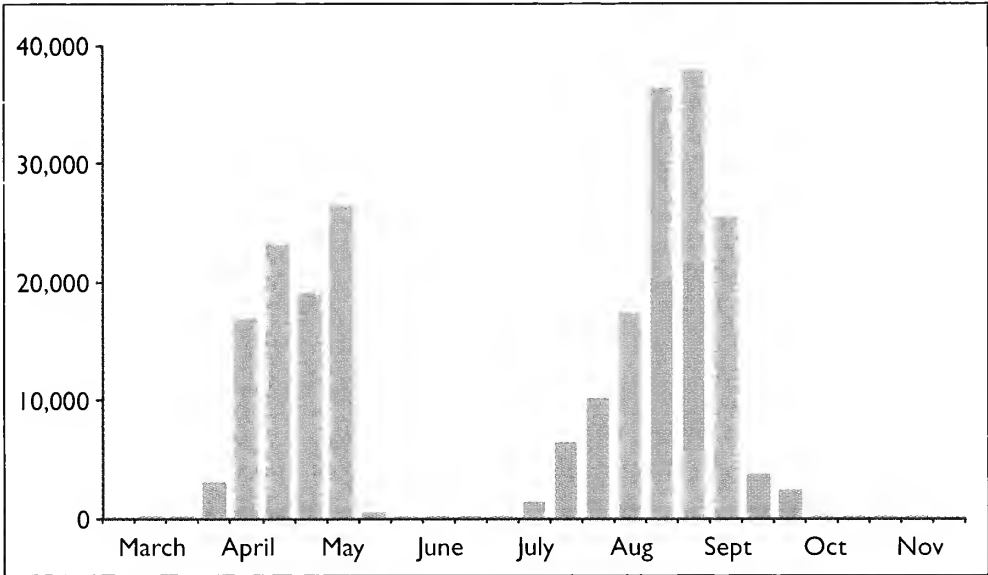
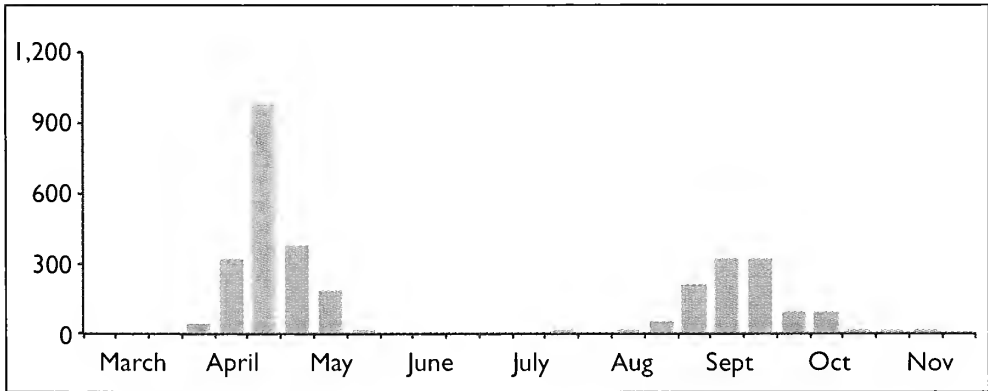


Fig. 4. Numbers of Common Terns *Sterna hirundo* at Cap Griz Nez, in ten-day periods, March–November 2007–II. Counts are in bird-days.





Paul Bowyer

93. Arctic Terns *Sterna paradisaea*, Weston sewage works, Avon, April 2013.

north again in early to mid April, travelling over deep water at a considerable distance from the margins of the continental shelf. They took a giant S-shaped route: northwards up the eastern South Atlantic before swinging west towards the coast of northern South America, in the region of the equatorial Intertropical Convergence Zone. They then travelled up the western or mid North Atlantic, back to their colonies. The 24,270-km return migration from Antarctica to Greenland took, on average, only 40 days; travelling an average distance of 520 km a day, the birds took full advantage of the prevailing wind systems to reduce energy costs. The Greenland birds exhibited clear synchrony in the timing of their migrations and observations indicated that migratory flock sizes are typically small, usually less than 15 individuals.

Fijn *et al.* (2013) carried out a similar research project in the Netherlands, where there is a small and declining population of Arctic Terns at the southern edge of their European breeding range. Their study showed that, on both their outward and their return journeys, five Arctic Terns fitted with geolocators visited a known 'staging area' in the North Atlantic (apparently the same as that used by the birds from Greenland and Iceland). From there, they headed east towards Portugal before moving south off the

African coast to a staging area over the Benguela Current, up to 1,000 km off the coast of Namibia (none of the Dutch birds used the South American route). Surprisingly, after reaching southern Africa, the Dutch birds then moved to a previously unknown staging area in the central Indian Ocean, 20–40°S and 65–100°E. Four then continued east into Australian waters before heading south to Wilkes Land, Antarctica, arriving there in mid November. The fifth bird continued to the Tasman Sea and south of the New Zealand mainland before also reaching Antarctic waters. Since leaving the colony, the birds travelled, on average, 29,700 km in 110 days, with a maximum migration speed of up to 690 km per day. All five then spent the Austral summer in Enderby Land and Wilkes Land, Antarctica, between 30°E and 150°E, an area completely separate from the Greenland/Iceland birds. They returned to their breeding colonies via the mid North Atlantic staging area, arriving back in the Netherlands at the end of April.

Discussion

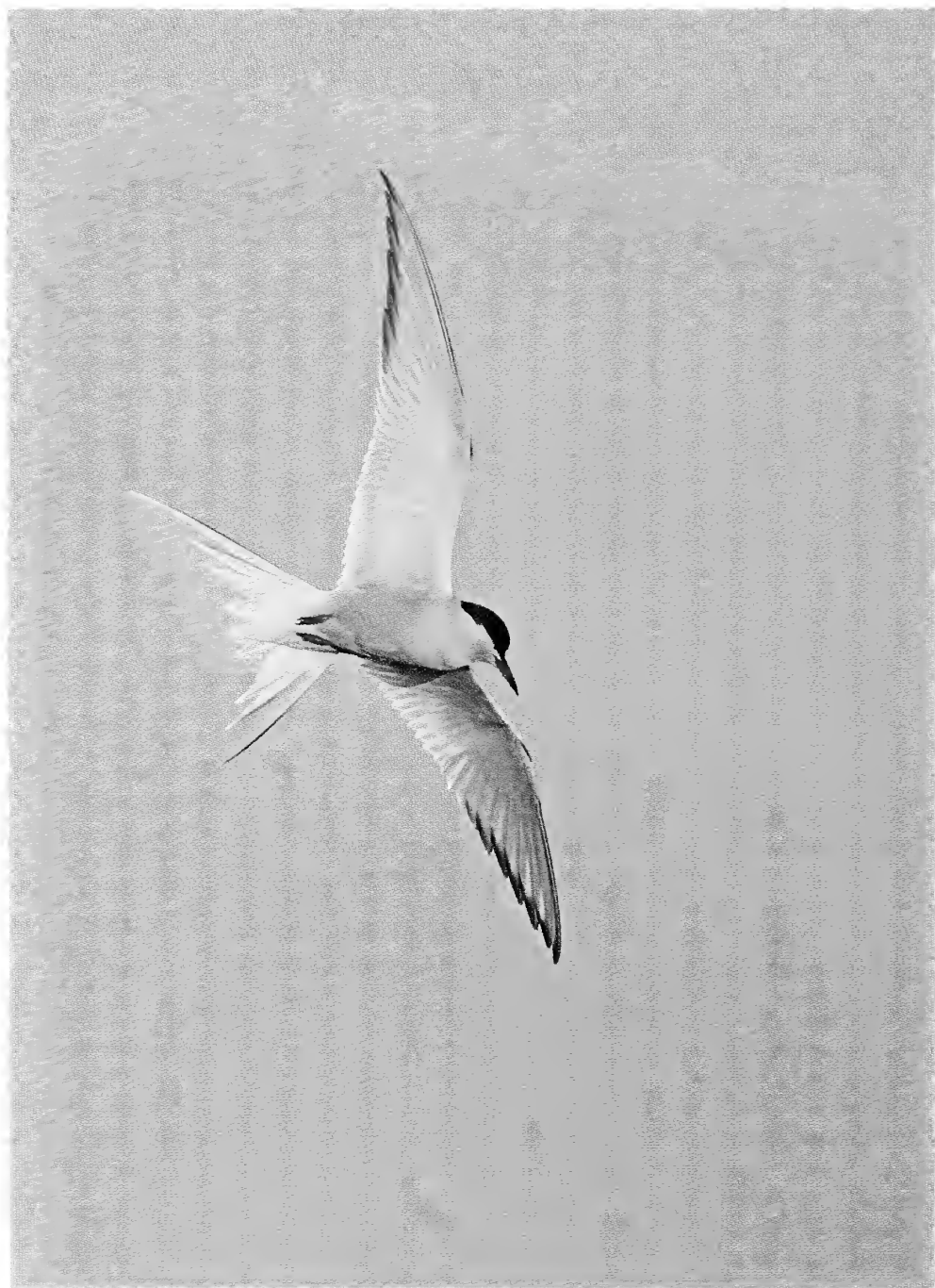
The data from Chew show that Arctic Terns regularly migrate overland, but it is also clear that inland records are often related to inclement weather, particularly westerly gales. It has long been suspected that there is a migratory 'short cut' in spring from the

Severn Estuary to the Wash (and vice versa in autumn), not only for terns but also for small numbers of skuas and other species, such as Common Scoter *Melanitta nigra*, Little Gull *Hydrocoloeus minutus* and Kittiwake *Rissa tri-dactyla*, all of which also appear at Chew on a fairly regular basis. This idea may of course be simplistic, since their movements are perhaps more likely to be on a broad front across the country. But the question concerning Arctic Terns is this: is there really a *regular* and *significant* cross-country passage in spring or is it the case that strong westerly winds occasionally funnel Arctic Terns into the Bristol Channel, the birds then having little option but to continue overland? Conversely, strong *easterly* winds also appear to deflect terns into the Bristol Channel, birds that would otherwise have moved east

through the English Channel (Brian Lancaster pers. comm.); this phenomenon is well known locally for spring Bar-tailed Godwits *Limosa lapponica*. However, in light of my limited observations at Portland, perhaps a more interesting question is whether there really is a significant passage of Arctic Terns east through the English Channel in spring, or indeed west through the Channel in autumn? In the county avifaunas of Dorset (Green 2004), Hampshire (Hampshire Ornithological Society (HOS) 1993) and Sussex (Sussex Ornithological Society 1996) substantive information on the status of Arctic Tern is lacking, the subject in all three counties being confused by identification difficulties. Interestingly, however, HOS stated that '*small numbers* [my italics] have been identified among the large flocks of

Common/Arctic Terns which move east along the coast between mid April and late May' and they go on to mention 'only seven other double-figure [spring] counts at coastal sites'. They also mention small autumn counts of up to seven, but with 15 seen along the coast during 17th–22nd October 1987, following the 'great storm' that autumn. The five birds recaptured in the Dutch study left their colonies in the first week of July and, having initially staged in the North Sea, they all started their southward migration at the end of July. Three travelled west down the English Channel but the other two moved due west to the Irish Sea, presumably following an overland route across Britain. From the Irish Sea they continued southwest to the staging area in the mid North Atlantic.

In general, data from seawatching headlands in



Gary Thoburn

94. Adult Arctic Tern *Sterna paradisaea*, Pilning, Avon, April 2013. This shows that not every 'Commic Tern' with a darker bill tip is a Common – early spring Arctics frequently show a diffuse black bill tip.

the English Channel present difficulties in that (a) many counts are made on an ad hoc basis; (b) distant birds are difficult to identify; and (c) there is the problem of picking out Arctic Terns from the overwhelming numbers of passing Commons. Nevertheless, the data from both Dungeness and Cap Gris Nez would seem to confirm the impression obtained at Portland that, normally, Arctic Terns do not use the English Channel in significant numbers, maximum counts being in the low hundreds rather than in the thousands.

In light of the findings of Egevang *et al.* and Fijn *et al.*, and also the fact that the largest influxes of Arctic Terns at Chew occur after westerly gales, surely the great majority of Arctic Tern spring migration is northwards over the Atlantic, the birds arriving on their British and north European breeding grounds mainly from the west. If so, their migration is much more akin to that of Pomarine *S. pomarinus* and Long-tailed Skuas, two other northern breeding species that are similarly scarce and rare (respectively) in the English Channel and the Bristol Channel/Severn Estuary. Presumably, the return (autumn) migration of the majority of Arctic Terns is similarly pelagic.

Despite the progress in identification criteria, the status of Arctic Terns continues to be bedevilled by identification problems: for example, tern flocks at Chew have been identified as different species by different observers at different times of the day. The problem is particularly acute, however, in the Bristol Channel and Severn Estuary, where large numbers of Arctic Terns are routinely reported in spring. In the ten years 2002–11, 15,748 coastal Common or Arctic Terns were recorded in the old county of Avon (*Avon Bird Report 2011*), although these totals make no allowances for repeat sightings of flocks moving up the estuary. Nevertheless, of those, 34.6% were identified to species level, of which 30.4% were identified as Common and 69.6% as Arctic. Thus, these figures suggest that Arctic Terns *outnumbered* Common Terns by 2.3:1, the reverse of the situation at Chew Valley Lake, Portland, Dungeness and Cap Gris Nez. At face value, this suggests that the relative abundance of the two species is different in the Bristol Channel and Severn

Estuary from that at Chew (just 25 km to the east); given that these coastal birds are also heading northeast for an overland crossing, this seems incongruous. These coastal counts have been questioned locally, with anecdotal reports of flocks being identified as different species as they moved up the estuary. Confidence has also been dented by limited photographic evidence. At the top end of the estuary, in Gloucestershire, most terns are identified as Arctics, few observers claiming large flocks as Commons. However, when the terns are studied at close range at Frampton Pools, adjacent to the estuary, most prove to be Commons (Martin McGill *in litt.*). Quite clearly, the relative status of the two species in the Bristol Channel and Severn Estuary requires clarification.

If, as these examples suggest, coastal birds are being misidentified, why is this so, in the light of more general progress? My own view is that too much reliance is being placed on a single identification feature: the presence or absence of a dark primary wedge in Common Tern. This difference, recognised so astutely by Hume & Grant (1974), relates to the fact that, whereas Arctic Terns moult their primaries only once a year (in winter), adult Common Terns moult their inner primaries twice a year (in late summer and late winter) but the outer primaries only once (in early winter). This means that, when the birds are in Europe, there is usually a contrast between the new inner primaries and the old outers. When new, the feathers have a pale grey bloom, which is steadily lost with wear to reveal progressively more of a blackish base colour (Hume & Grant 1974). Consequently, the older outer primaries are darker than the newer inners, producing a large dark wedge that is obvious at some distance. However, this contrast is most obvious in late summer and autumn and is least obvious in spring, particularly at a distance. In spring and summer, many Commons show only a faint wedge, confined to the middle primaries, which can be difficult to detect at any distance, while some unworn individuals – perhaps mainly second-summers – appear to lack a wedge altogether (Vinicombe *et al.* 2014). Consequently, distant spring Common Terns are prone to being misidentified as Arctics. This problem is particularly acute with flocks flying low and fast

over the waves – often with a ‘whippy’ flight action – and is exacerbated by bright light, when they may appear very white. Birders are therefore urged to exercise caution in spring, especially with distant birds, most of which are probably best logged as ‘Commic Terns’.

As discussed above, whereas the Common Tern is a bird of inshore waters, apparently hugging the European and West African coasts during its migrations, the Arctic Tern is a highly pelagic species, its annual migrations showing strong parallels with, for example, those of the Manx Shearwater *Puffinus puffinus*. There seems to be little reason why large numbers should pass through southern Britain, either off the coasts or inland. Those that intentionally do so are perhaps mainly birds taking the shortest route to and from breeding colonies in northeast Britain, the Netherlands, southern Scandinavia and the Baltic.

It is recommended that birders in southern Britain work on the assumption that, in normal circumstances, Common Terns are far more numerous than Arctic Terns, outnumbering them by somewhere in the region of 5:1 to 180:1, the ratio usually being higher if there are breeding colonies of Common Terns nearby. In the south, it seems that Arctic Terns are likely to outnumber Commons only after westerly gales and/or in late September and October, after the peak of the autumn Common Tern migration is past and when most records of Arctics relate to the more easily identified juveniles.

Postscript: spring 2013

Although (frustratingly) I was not there to witness the biggest days, in 2013 Chew experienced the highest spring passage of Arctic Terns on record. A high count of 88 Common Terns on 16th April was followed by a record 134 Arctic Terns on 18th, the influx being related to a long period of persistent southerly followed by westerly winds (these data are not included in the text and figures above). Between 9th and 19th April, the daily wind speed at nearby Bristol Airport averaged 25.5 kph and peaked at 48 kph on the big influx

day of 18th, with gusts of up to 67 kph (data from www.wunderground.com). The influx was also recorded at many other sites in and around the Bristol Channel and Severn Estuary, including provisional reports of up to 50 at Cheddar Reservoir and 100 at Burnham-on-Sea (both Somerset), 84 at Weston-super-Mare and 50 at Severn Beach (both Avon), and 100 at Frampton-on-Severn, 130 at Slimbridge and 200 at Newnham on Severn (all Gloucestershire). Similar numbers were also reported in the Midlands and northwest England. Again, the correlation of this influx with strong westerly winds is striking.

Acknowledgments

I am very grateful to Andy Davis for his help in obtaining data, references and for reading an earlier draft; to Martin McGill for information and useful comments from Slimbridge, Gloucestershire; to Brian Gibbs for providing information from Somerset; to David Walker for providing data from Dungeness; to Rob Bijlsma for sending me a copy of the Dutch paper published in *Ardea*; and to Martin Cade, Brian Lancaster, Richard Mielcarek, Dick Senior and Chris Stone for helpful discussions on the subject. I am also grateful to Richard Andrews for his help with the graphs and to Mark Ponsford for additional information.

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Keith Vinicombe, Bristol

Keith Vinicombe is a retired civil servant who made his first visits to Chew in 1963 and is still a patch regular there.



The Bernard Tucker Memorial Lecture

What it's like to be a bird

Tim Birkhead

Abstract The study of behaviour, much of it based on birds, became established in the first half of the twentieth century. At that time researchers were anxious that this new area of research should be both distinct and objective. They set clear boundaries about what was and what wasn't appropriate to study. The idea that birds might have feelings or emotions was out of bounds because it was both difficult to study and vulnerable to anthropomorphism. More recently, as the study of behaviour has increased in maturity and confidence, and with the introduction of new technologies such as functional magnetic resonance imaging (fMRI), researchers have started to explore the sensory biology of birds, including their emotions, with some startling discoveries that change the way we think about birds.

In the 1980s, I studied Common Guillemots *Uria aalge* and other seabirds in Labrador, on a group of six tiny islands called the Gannet Clusters. The three field seasons I spent there comprised one of the most enjoyable periods of fieldwork I've ever done. They also changed the course of my career. Like most seabirds, Common Guillemots are socially monogamous but, as I knew from my PhD work a few years earlier, extra-pair copulations are surprisingly frequent. Labrador provided me with the opportunity to show that extra-pair copulations were adaptive – but that's another story. What I want to do here is to mention one of many casual observations of Guillemot behaviour that altered the way I think about birds in general.

My second field season in Labrador was a particularly cold one with the sea ice persisting much later than normal. Just like the Guillemots, we arrived at the colony to find their breeding areas covered in a metre or so of hard-packed snow. As the birds started to visit the colony, I realised that even though they were standing on snow, the pairs were all in precisely the same configuration as they would be with no snow present. Without being able to see it, each pair knew exactly where its breeding site was and as the days passed they

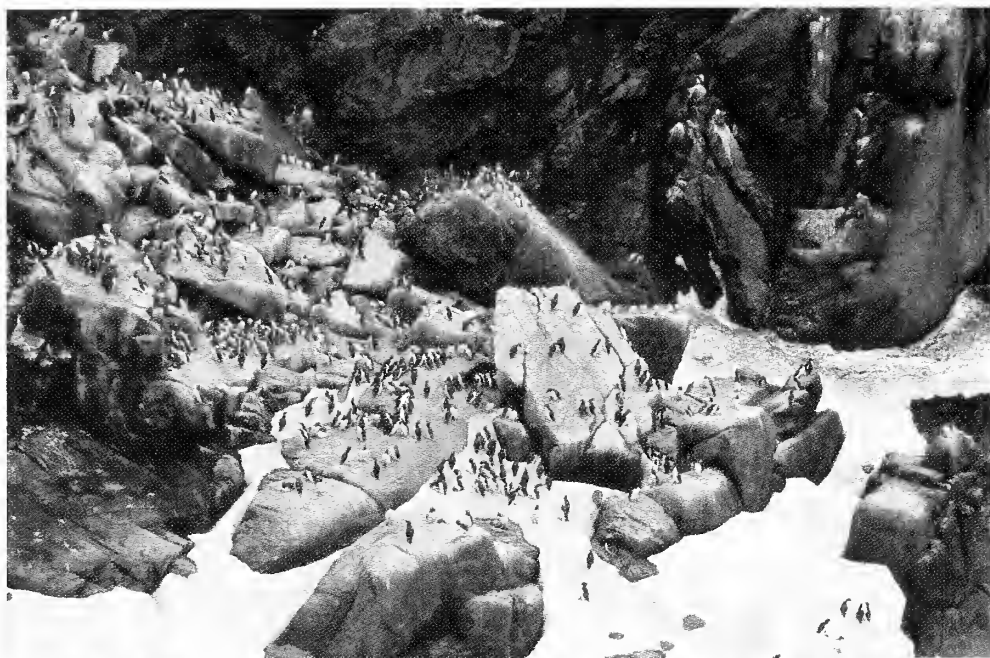
melted through the snow, often in a kind of tube, until they eventually reached the bare rock of their breeding site (plates 95 & 96).

How did they know where to alight? The only reasonable answer is that Guillemots have an exceptional sense of spatial awareness. If you think about it, they must have. Not just in terms of finding their few square centimetres of breeding site, but finding their breeding islands after a feeding trip through the thick fog that was so characteristic of the Labrador summer.

It was incidents like this that changed the way I thought about birds. What kind of sense was it that allowed Guillemots to know exactly where their breeding site was even though it was invisible beneath the snow? As far as I was aware, no-one had ever given such observations much thought.

The only way we can possibly imagine what it is like to be a bird is by comparing birds to ourselves. The problem with that is that we are then tempted to assume that birds perceive the world in the same way that we do and that birds feel the same as we do under similar circumstances. When a Great Tit *Parus major* is chased by a Sparrowhawk *Accipiter nisus*, does it experience fear in the same way that we would do if chased by a fierce dog? If the Great Tit avoids the Spar-

Tim Birkhead



Tim Birkhead



95 & 96. Common Guillemots *Uria aalge* on the Gannet Clusters, Labrador, in June 1982, melting slowly through the snow to their breeding sites.

rowhawk's talons and escapes, does it feel the same sense of elation and relief as we would if we managed to escape from that fierce dog?

It is precisely because it is so difficult to know whether birds (or other animals) feel the same as we do that, when the scientific study of animal behaviour was getting started in the 1950s, Niko Tinbergen (one of the subject's founding fathers) explicitly excluded emotions as a research topic. He did so because emotions are technically difficult to study and because he was at pains to make the fledgling study of behaviour objective, scientific and free from anthropomorphism. Earlier studies of behaviour, such as those by George Romanes (1882), comprised little more than anthropomorphically interpreted anecdotes.

But just as Tinbergen could see how the study of behaviour had advanced since

Romanes's day, we too can look back to the 1950s and see how far we've come. We have come a long way, and thanks to Tinbergen and his Nobel Laureate colleagues, Konrad Lorenz and Karl von Frisch, and legions of others since, the scientific study of animal behaviour is now well established. In fact, it is sufficiently well established that researchers are beginning to feel confident enough to study aspects of behaviour that Tinbergen and his colleagues studiously avoided, such as cognition (clever birds), personality, and, yes, even emotions (Birkhead *et al.* 2014; chapter 7).

Like all new areas of research, the study of emotions is controversial and so fraught with difficulties that views often become polarised. At one extreme, hard-nosed psychologists proposed that unless animals possess consciousness they cannot perceive

emotions. At the other extreme, some people believe that animals experience everything as we do. As always in such cases, the truth lies somewhere in between. But where? And does it differ between species?

One of the main obstacles to the study of emotions is that they are difficult to define, even in humans, so it is hardly surprising that they pose special difficulties in non-humans. Charles Darwin, who is often regarded as the first animal behaviourist, tried to get to grips with this kind of issue, and did so using a pragmatic and simple solution. One way, he said, of thinking about feelings, is to imagine a continuum, with pleasure at one end and displeasure (discomfort, pain) at the other (Darwin 1871). This is the approach I adopted to explore the emotional aspects of bird behaviour in *Bird Sense* (Birkhead 2012). It seems sensible to me, when dealing

with a complex topic, to keep it simple. It might not be absolutely right, but you are less likely to get it wrong than if you devise an unnecessarily complex system.

Using this continuum, can we tell whether a bird feels an emotion? The easiest way to start thinking about this is to ask how we would respond to something pleasurable or painful. Imagine for a moment that your lover is tickling the back of your neck. Since that is a pleasurable sensation you would be disinclined to move away. Your brain would be saying 'give me more of that' and you'd probably be smiling. Now imagine you are in the dentist's chair about to have an injection in the front part of your mouth – your brain is screaming 'get me out of here' and you'd probably be grimacing. There: we've just spanned much of the pleasure–displeasure continuum, and we have also performed behaviours – facial expressions – that would provide a human observer with a clue to the emotions we were experiencing. Birds, however, don't have facial expressions so it would not be possible to do the same with them.

However, birds have the ability to move, and this can allow us to use the pleasure–displeasure continuum to make judgements about what they are feeling. Indeed, researchers like Marian Dawkins at Oxford University (one of Tinbergen's former students), who is interested in animal welfare, uses this approach to establish what it is that battery chickens want. The rationale is simple: animals remain stationary, move towards or will work hard to achieve something they consider pleasurable, but will do the opposite to avoid something displeasurable. Using this simple kind of behavioural assay is a particularly effective way to begin to understand how animals feel (Dawkins 2006).

However, it isn't always straightforward. One day while I was studying Guillemots on Skomer, in Pembrokeshire, I saw a Peregrine Falcon *Falco peregrinus* catch a Puffin *Fratercula arctica*. The Peregrine was flying casually along the clifftop, a metre or so above the ground. The Puffin waddled out of its burrow looking in the other direction and the Peregrine simply landed on the Puffin, clutching it in its talons. The Puffin lay on the ground looking up at its captor, and the Peregrine looked assiduously out to sea. The

Puffin made no sound, but I could see through my telescope that it was very much alive. After 15 minutes, the Peregrine started to pluck the breast feathers and to eat the Puffin and only after a further 15 minutes did I judge the Puffin to be dead.

On another occasion while studying wild Zebra Finches *Taeniopygia guttata* in Australia, I saw a Brown Falcon *Falco berigora* take a Galah *Eolophus roseicapilla* from a flock that was flying overhead. Galahs are noisy at the best of times, but the one captured by the falcon screamed and screeched like a baby. The falcon took the parrot into a tree where I could no longer see what was happening, but I could hear it and for 15 minutes the Galah continued to shriek abominably.

In the case of the Puffin, one might have watched an incident like that and deduced that because there were no outward signs of distress whatsoever that birds, or Puffins at least, have no sense of pain. In the case of the Galah, everything indicated that that bird was in terrible distress and obviously experienced pain in much the same way as humans would. These examples demonstrate how careful one must be about drawing inferences.

The difficulty, of course, is how we judge *objectively* what an animal is feeling.

There are other techniques too. One can measure breathing rate and heart rate (both of which increase with displeasure or stress); and one can use fMRI (functional magnetic resonance imaging) to look at which parts of the brain 'light up' under different circumstances and draw inferences from what is known about what different parts of the brain detect, as has been elegantly demonstrated in some pioneering studies of American Crows *Corvus brachyrhynchos* by Marzluff *et al.* (2012).

Emotions are just one of several senses that birds possess, but they are the most controversial. It is easier to assess how well a bird sees because this is something we can measure objectively. At least, we think we can. Vision is, of course, the sense we first think of with birds since most of them rely so heavily on eyesight. In addition, vision is one of our primary senses, so it makes it easier for us to imagine what birds see.

Vision

The fact that certain birds (such as raptors) have much greater visual acuity than us has been known for a long time – hence terms like ‘eagle-eyed’. I’ve never heard of anyone being referred to as shrike-eyed, but that would be appropriate too for, like eagles, hawks and falcons, shrikes have exceptionally good eyesight, and far better than our own. In the past, when falconers trapped migrating raptors to train them, they often used a trapping device that involved a Great Grey Shrike *Lanius excubitor*. The falconer constructed a hole in which he could conceal himself, and outside it he created a mound of earth on top of which was a miniature hut or shelter in which the tethered shrike could conceal itself – when necessary. The shrike sat outside the hut watching the horizon, and the falconer lay in his hole watching the shrike. The falconer could tell from the shrike’s behaviour whether a falcon was approaching, long before the falconer could see the falcon. Not only that, the falconer could tell from the shrike’s behaviour exactly how the raptor was

approaching: fast, slow, high, low, etc. As the falcon approached, the shrike dodged into the safety of the little hut provided by the falconer (fig. 1).

How can falcons and shrikes see so much better than we can? We know enough about the structure of the mammalian eye to make some judgements. We know, for example, that the type and density of light-sensitive cells on the back of the retina varies among species and determines visual acuity. We also know that the eyes of certain birds are (in relative terms) much larger than our own, and that the larger the eye, the greater the visual acuity, simply because a larger eye contains more light-sensitive cells. But the eyes of certain birds differ from those of mammals in another way. The most sensitive part of our own retina is called the fovea – it is a region where the density of light-sensitive cells is greatest. When we are looking at something carefully, we position it, or our head, such that the image falls onto this part of the retina. Certain birds, including raptors, possess two of these ‘hot spots’ on the retina:

effectively, one works as a close-up lens, the other as a telephoto lens. These two foveae are referred to as the shallow and deep foveae respectively, and in birds with only one it is the shallow fovea. The deep foveae are positioned in such a way in the eyes of raptors that they have some degree of binocular vision, which is presumably helpful for judging distances when pursuing prey. What about shrikes, do they have one or two foveae?

The answer to this was provided by a pioneering American ophthalmologist, Casey Albert Wood (1856–1942). Wood was one of the top eye specialists in the USA and he liked birds. (He liked bird books even better and accumulated one of the best ornithological libraries in the world – the Blacker-Wood Library – which is now located at McGill University in Montreal and named after his friends Mr and Mrs Robert Blacker and his wife Emma Shearer Wood.) Using the same ophthalmoscope he used on his human patients, Wood examined the retinas of a large number of bird species in the hope that understanding their excellent eyesight might give him some

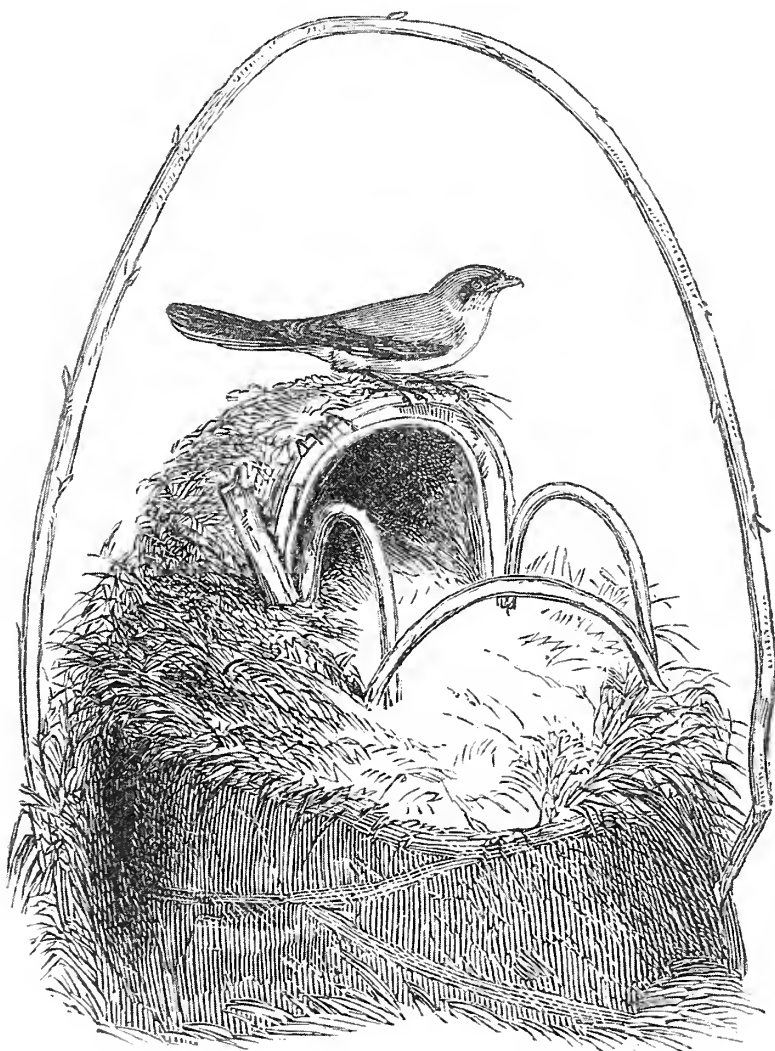


Fig. 1. A Great Grey Shrike *Lanius excubitor*, used by falconers as an early warning system by those catching migrating falcons in the Netherlands (from Harting 1883).

useful insight into human eye disorders. His efforts were eventually published in a book, the title of which couldn't have been less exciting: *The Fundus Oculi of Birds* (1917). He could have called it 'the retina of birds', for that was what it was about, although that would hardly have made it more appealing. The book contains some beautiful images of the retinas of different birds, illustrated by an artist, because at that time obtaining a photographic image of a bird's retina was technically impossible (fig. 2).

As well as revealing the fovea, and showing that the Loggerhead Shrike *L. ludovicianus* has two fovea, these images illustrate another extraordinary feature of birds' eyes, a structure called the pecten. If you can face it, the next time you find a dead bird, say killed on the road, very carefully open an eyeball with a razor blade. In the rear chamber of the eye, and attached by a stalk to the retina is a surprisingly large, pleated structure: the pecten. Its size is surprising because it is hard to imagine something so enormous sitting inside the eye without impeding vision. But it doesn't. Remarkably, the pecten is positioned in such a way that its shadow falls on the blind spot of the retina – the point where the optic nerve enters the eye – and therefore has no detrimental effect on vision. The pecten (which means 'comb') was first discovered in the 1600s, and as more and more birds were examined anatomists began to see a pattern: birds with bigger and more structurally complex pectens tended to be those with the most acute vision. Kiwis (Apterygidae), renowned for their extremely poor vision, were thought not to possess a pecten at all, but Casey Wood showed that they did have one, although it was very small. So what does the pecten do? Birds are unusual in that there are no blood vessels in their retina, but the

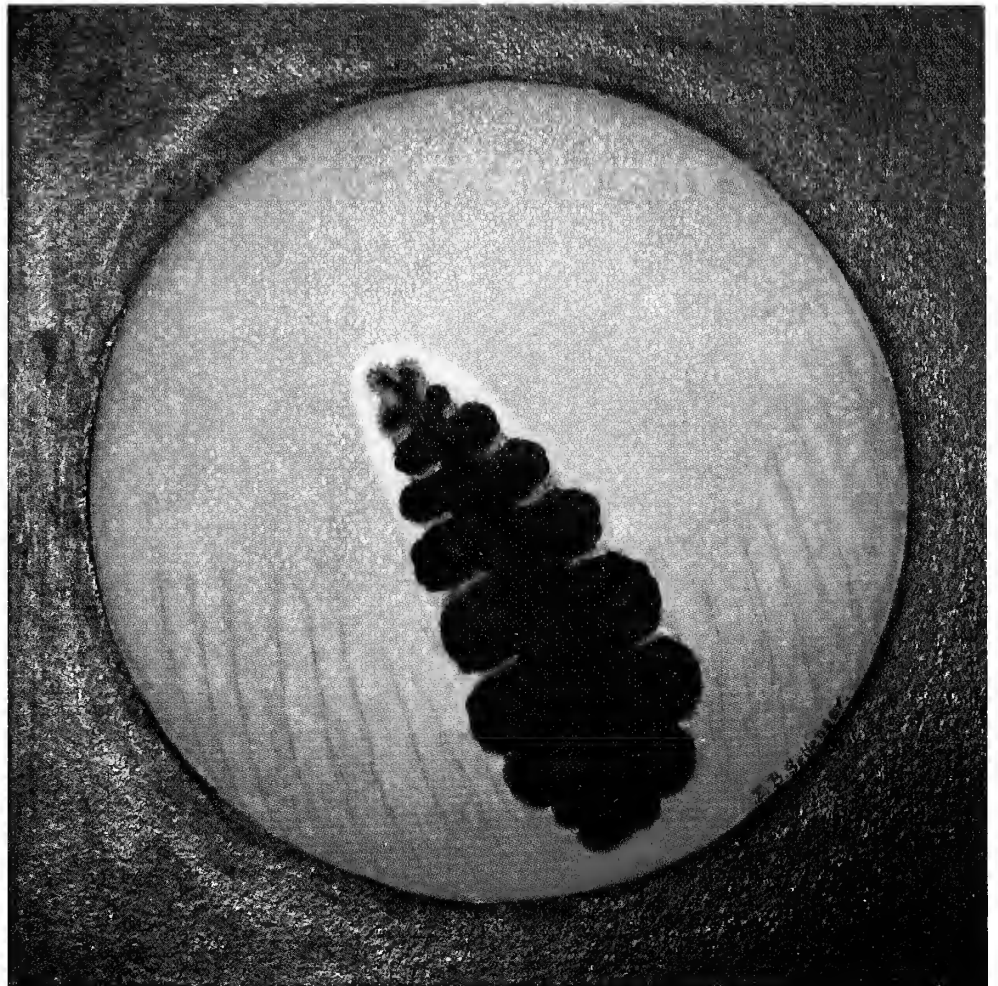


Fig. 2. The retina of a Wandering Albatross *Diomedea exulans*, as seen through an ophthalmoscope; the large, dark, pleated structure is the pecten (from Wood 1917).

pecten is thick with them. The function of the pecten, its massive surface area created by its pleated structure, is for gas exchange within the eye. The pecten allows the eye to breathe.

There are other differences between the eyes of birds and humans, most notably the ability to detect ultraviolet (UV) light. It was Darwin's friend and neighbour John Lubbock who in the 1880s recognised that ants could detect UV light. Soon afterwards the same ability was detected in bees, and for a while it was assumed that this particular sense was restricted to insects. Then in 1970 it was found that pigeons were sensitive to UV. No-one really paid much attention until the study of sexual selection, and mate choice was reinvigorated by the birth of behavioural ecology in the late 1970s, when it was realised that UV vision may be important in selecting a partner (Hill & McGraw 2006).

Darwin's concept of sexual selection provided an ingenious explanation for why males and females often differed in their appearance, a phenomenon particularly noticeable in birds. Darwin's idea was that showy males (occasionally females) evolved

either because they were better at fighting rivals (for example because of their larger body size or, in gamebirds, spurs), or because females preferred them. Elaborate traits (such as the tail of the Peacock *Pavo cristatus*) evolved despite being an encumbrance because the evolutionary costs were more than offset by the greater reproductive success that such males achieved. Darwin's idea was sheer genius, but it was not until the 'behavioural ecology revolution' that we recognised it. Why?

The answer was 'individual selection' (caricatured as 'selfish gene' thinking, after Richard Dawkins' book *The Selfish Gene*, published in 1976, which spelt out the logic). Prior to the mid 1970s, many people, including many ornithologists, thought in terms of 'group selection' – things evolved for 'the good of the species'. Under that evolutionary scenario it didn't matter who mated with who because all that really mattered was that a species survived. Group selection was wrong (to put it simply): natural selection operated on individuals not groups nor species, but it took a while for biologists to realise this. Among the pioneers of individual-selection thinking was David Lack, arguably the most influential ornithologist of the twentieth century (Birkhead *et al.* 2014). But it took Dawkins to convince (almost) everyone else that the only way to think about natural selection was in terms of individuals. For a recent overview see Davies *et al.* (2012).

This small digression on sexual and natural selection sets the scene for the study of mate choice and avian vision. How do females discriminate between males; how do they decide which is the 'best' male to mate with? In many cases, females seem to make their choice based on the male's plumage. In North American House Finches *Carpodacus mexicanus*, for example, females prefer redder males. Males of this species vary from red through to orangey-yellow, depending partly on how good they are at acquiring carotenoids from their diet. Females prefer redder males because these males are of higher quality. It seems that our perception of the redness of a male House Finch is similar to a female House Finch's perception, but this isn't true for all colours.

Some behavioural ecologists began to wonder whether certain male plumage features might be visible only if you have UV vision. Sure enough, it was discovered that in the Blue Tit *Cyanistes caeruleus* the male's crown plumage reflects in the UV, and females can detect it. Not only that, the better the UV reflectance the more attractive the male is to the female because, presumably, like the red colour in the House Finch, this says something about the male's quality, and in this case his ability to make feathers that reflect well in the UV.

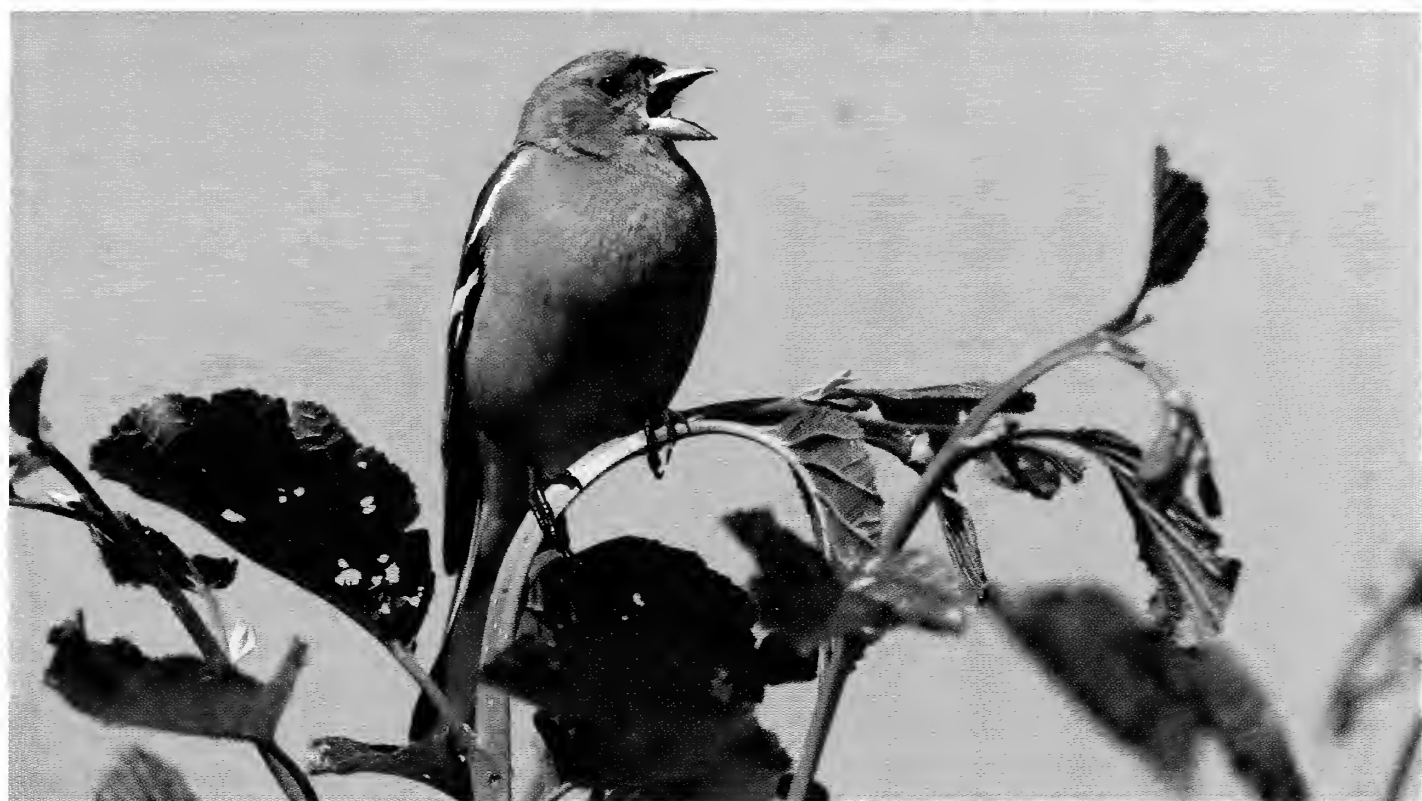
Because we cannot see in the UV portion of the light spectrum, it is hard for us to imagine what it must be like being a female Blue Tit. In fact, by thinking that this is the only difference between human and avian vision we may be deluding ourselves since the structure of a bird's retina suggests that birds may also see other colours differently from the way we do.

Sound

Hearing is another sense where we might be tempted to assume that birds are similar to ourselves. Given how important vocal communication is for birds, through their songs and calls, and how much we know about their vocalisations (e.g. Catchpole & Slater 1995, Marler & Slabbekoorn 2004), we know surprisingly little about their hearing. What we do know is that the range of sounds birds can hear, from the deep booming of a Eurasian Bittern *Botaurus stellaris*, to the high-pitched twittering of a Goldcrest *Regulus regulus*, is broadly similar to our own. Perhaps not surprisingly, small birds are better at detecting and discriminating between high-pitched sounds than low-pitched ones, and large birds vice versa.

Birds are also much better than we are at resolving complex sounds. We are all familiar with sonogram images of bird song, and how some songs are composed of units sufficiently distinct that we can 'decipher' them without too much difficulty. The song of the Common Chaffinch *Fringilla coelebs* is easily rendered into its various four phrases (each composed of several syllables), thus: chip-chip-chip-chip – tell-tell-tell-tell – cherry-erry-erry-erry – tissy-che-wee-ooo (fig. 3).

In contrast, there are many bird songs



Mike Lane

97. Singing male Common Chaffinch *Fringilla coelebs*, Wales, June 2006.

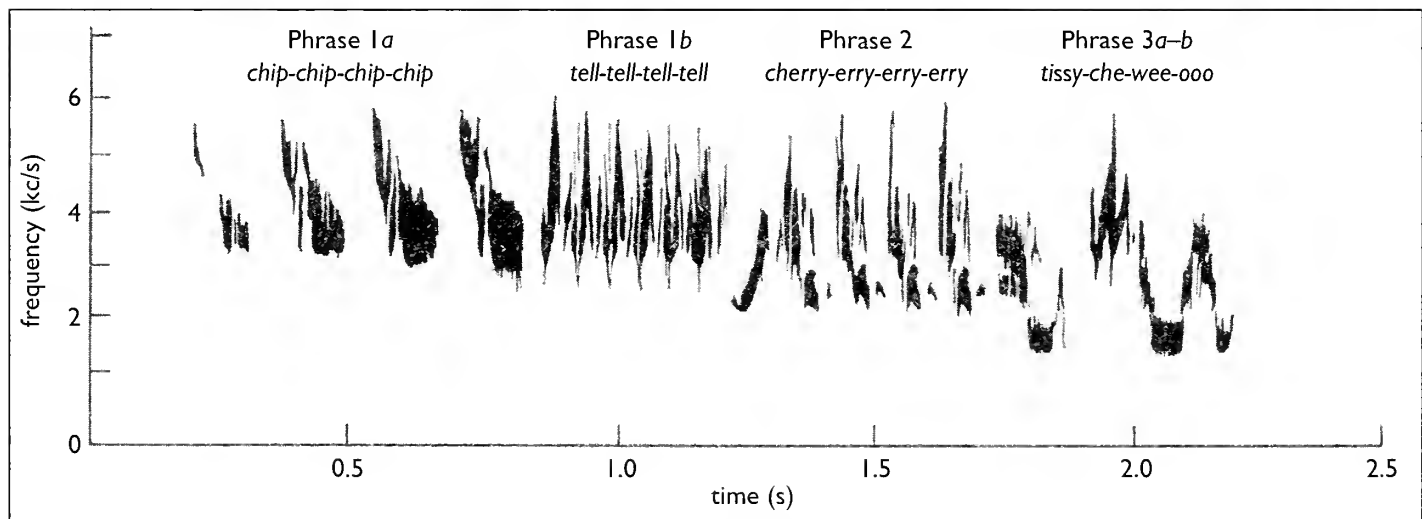


Fig. 3. Sonogram of Common Chaffinch *Fringilla coelebs* song (from Thorpe 1961). The invention in the 1940s of the sonograph, which provides a picture of sound (with duration along the horizontal axis and pitch, or frequency, along the vertical axis), revolutionised the study of bird song. Here, the match between the sonogram and the phonetics of the Chaffinch’s song is clear.

where the syllables are so close together that our brain simply cannot distinguish them. That birds can often do so was beautifully demonstrated in the 1950s by a Northern Mockingbird *Mimus polyglottos*. An American ornithologist named Hudson Ansley had made an audio recording of a Whip-poor-will *Caprimulgus vociferus* (an American nightjar), whose name also describes its call. If you listen to a Whip-poor-will, its call sounds as though it is made up of just three notes: ‘whip’, ‘poor’ and ‘will’ (or if you are using David Sibley’s field guide (Sibley 2000): WHIP puwiw WEEW). However, when Astley looked at a sonogram of the bird’s call, it was clear that it comprises five notes, not three. It is just that our brain doesn’t

function fast enough to hear more than three notes. The question was, do birds hear three or five notes? The answer was provided by a Mockingbird – so-named because it is a great mimic. A sonogram of a Mockingbird mimicking a Whip-poor-will revealed five notes rather than three (Ansley 1954).

There’s another extraordinary example of the ability of birds to decode song more efficiently than we can. When a male Canary *Serinus canaria* sings to his partner just before the onset of egg-laying, she often responds by squatting and soliciting copulation. What she is responding to is a set of rapidly alternating high- and low-frequency sounds uttered at about 17 times per second, embedded within the whole song. On a sonogram these pairs of

notes are obvious, but to the human ear they sound like a continuous trill. Because of the effect they have on the female Canary, they are referred to as sexy syllables.

One of the most remarkable aspects of avian hearing is that, in some species at least, it varies seasonally. Jeff Lucas, studying three North American passerines, the Black-capped Chickadee *Poecile atricapillus*, the Tufted Titmouse *Baeolophus bicolor* and the White-breasted Nuthatch *Sitta carolinensis*, found that both the ability to detect sounds and the ability to interpret sounds were greatest during the breeding season. While this seasonal change in hearing is unexpected, it is also understandable in that this is when these species sing and have to be sensitive to the songs of potential rivals and partners. But why bother changing your hearing ability across the year? The answer is: probably for the same reason that many birds breeding in temperate regions also undergo massive seasonal changes in size and structure of both their brain and their gonads.

Let's start with gonads; they're easier. If you dissect a small bird in winter, you may have difficulty even finding its gonads, regardless of sex, because the reproductive organs regress to almost (but not quite) nothing outside the breeding season. With the onset of spring, and usually in response to increasing daylength, the gonads start to increase in size, reaching their maximum just before the start of the breeding season. The changes in male gonad size coincide with the production of song: birds seem to need enlarged gonads to sing. There's more to it than that, but that's the basic story. Those seasonal changes in avian gonad size have been known since the time of Aristotle (300 BC).

What about the brain? No-one expected a bird's brain to change with season. But it does – as was discovered in the 1970s. The story begins a few decades earlier, however, in the 1940s, when Canaries were still popular and kept for their cheerful, varied song. Since only male Canaries sing, half the output of a Canary breeder (i.e. the female birds) is worthless. Unscrupulous dealers found that by giving female Canaries a shot of testosterone – which was first artificially synthesised and hence readily available in the 1940s

– they would sing like a male – albeit for only a couple of weeks. This was good for Canary dealers, less good for those duped by these singing females, but it wasn't for a few years that biologists asked what might be going on in a female Canary's brain that allowed this to happen.

It turned out that female Canaries given testosterone showed a change in their brain structure. The regions of the brain responsible for song, which are normally large in males and small in females, grew in those females dosed with testosterone. This was completely unexpected because the conventional wisdom across the entire field of neurobiology was that neurons could not repair themselves or regrow. That's why brain injuries and degenerative diseases are so devastating in humans. The Canary studies changed all of that forever, resulting in a major revolution in neurobiology and giving hope to those suffering from diseases like Parkinson's and Alzheimer's. This is also a very good example of why it is important that governments continue to fund 'blue skies' research: one can never anticipate what might be important! In the current cash-strapped climate, funding a study of bird behaviour might seem pointless; but it might not be.

Almost as remarkable as the seasonal changes in brain size, gonad size, song production and hearing ability in birds is the fact that humans also show a kind of seasonal variation in their hearing ability. In fact, only women show this ability, and it is related to the hormone oestrogen. When oestrogen levels are high, male voices sound richer, and the change may therefore be related to mate choice, much as it is in birds. Tests by psychologists show that for most women this effect is so subtle that they are not conscious of it. (However, once after I had given a talk on this topic, a young woman came up to me and told me that she had a condition that meant that at different times of her menstrual cycle she was very conscious of how different men's voices sounded. Sadly, she disappeared before I could ask her more about it.)

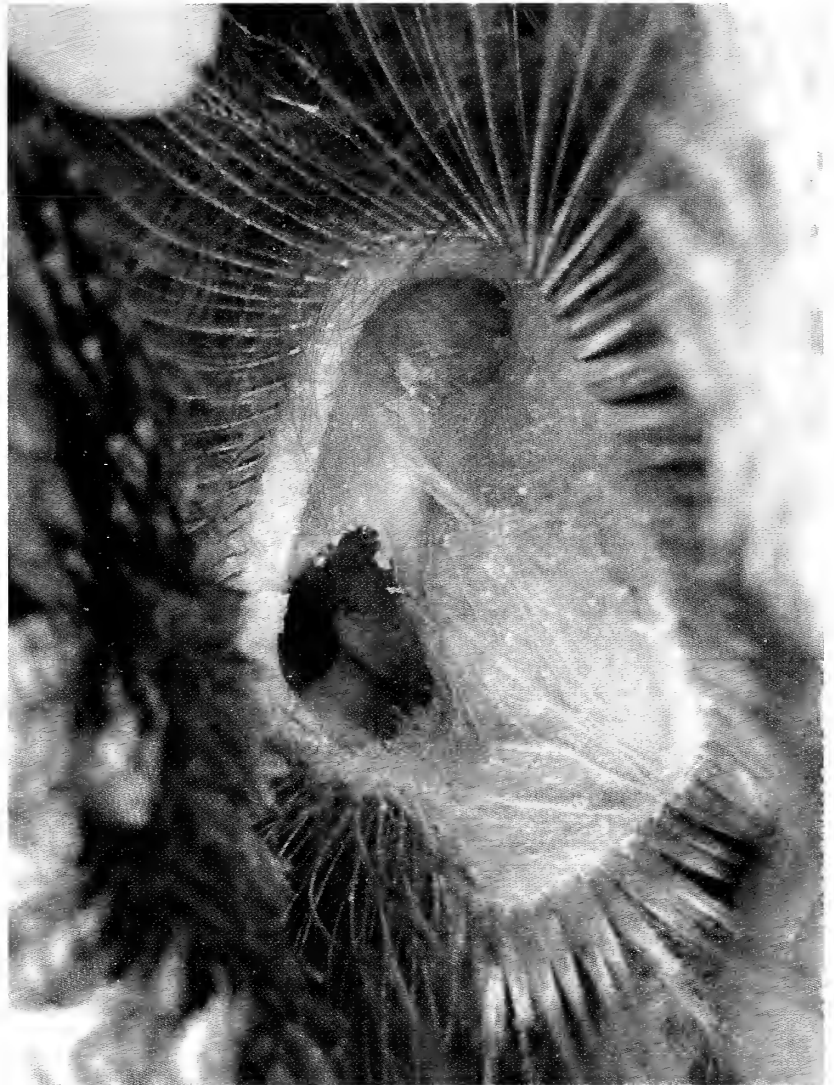
The hearing of certain owls is extremely sophisticated in that they can pinpoint sound, like the scrabbling of a mouse in the

dark, with extreme accuracy. The Great Grey Owl *Strix nebulosa* is one of the best examples of this, being a daytime hunter and perfectly capable of catching rodents out of sight beneath the snow by hearing alone.

The Great Grey Owl possesses a number of adaptations to facilitate this. The first is its facial disc. This is a sound-capturing device, and works in the same way as cupping your hands behind your ears. I'm always surprised what a marked effect this has on what I can hear, and I imagine that the feathered facial disc has an even bigger effect for the owl. In fact the Great Grey Owl's facial disc is relatively enormous, as I discovered when I had access to one and placed my hand behind those feathers to try to find the ears. I was amazed by how long those feathers that make up the disc really are – almost 10 cm. Of course, the larger the facial disc, the more sound is captured, and the more information the owl has about the source of the sound. But size isn't everything, and the nature of the feathers that make up the facial disc must be important too. The Great Grey Owl has unusual feathers towards the bottom of the facial disc, with a very broad flat rachis, whereas those feathers towards the top are much more delicate with a normal rachis. As far as I know, no-one has ever looked in detail at why the feathers around the facial disc differ so much in structure.

To examine the ear openings you must gently fold the feathers of the facial disc forward. You will need some help doing this because you need to keep tight hold of the owl's powerful legs and feet, as well as its beak! The beak isn't dangerous, but it helps if you can keep the owl's head still. The bird I examined was remarkably tolerant and lay in my lap like an enormous feathery baby. The ear open-

ings are huge, about 4 cm from top to bottom, and therefore much larger (in relative terms) than our own. Even more remarkable, which is clear from the image in plate 98, the openings are covered by a flap, and judging from the folds of skin on the flap the



Tim Birkhead

98. Ear of a Great Grey Owl *Strix nebulosa* – note the different-shaped feathers surrounding the ear opening. The bird is facing to the right.



Tim Birkhead

99. Great Grey Owl *Strix nebulosa* in the hand, with fingers pointing to the location of the asymmetrically placed ear openings hidden beneath the facial disc.

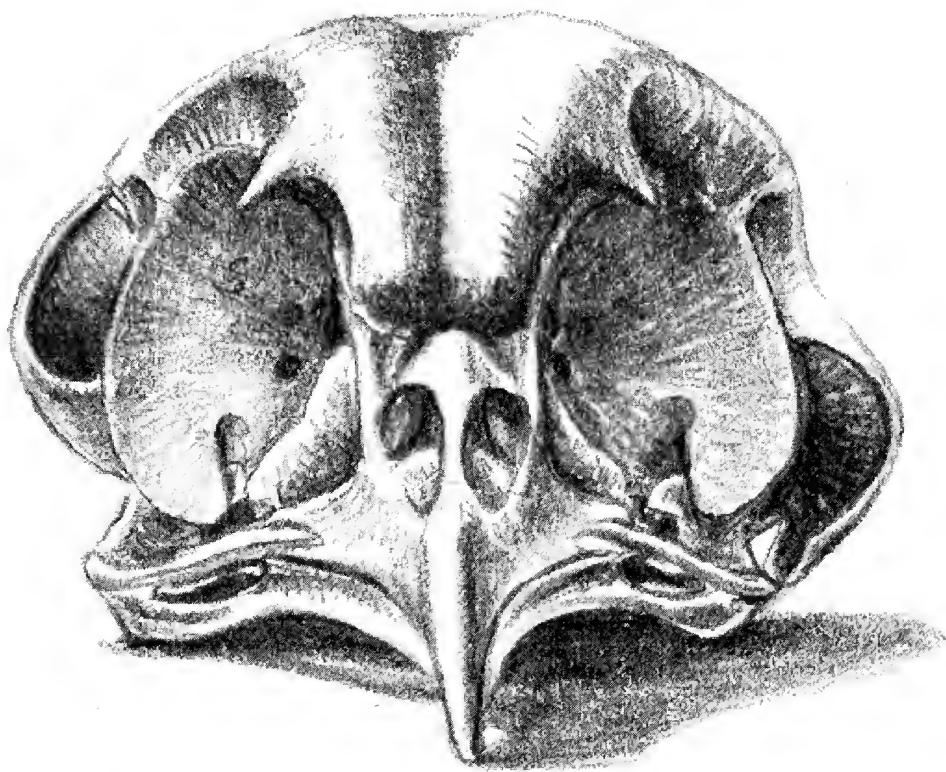


Fig. 4. Skull of a Northern Saw-whet Owl *Aegolius acadicus*, drawn by Katrina van Grouw (from Birkhead 2012).

owl probably has quite a lot of control over how much they are open. Again, no-one seems to have ever studied this.

The final adaptation to maximise the localisation of sound is the relative position of the ears on each side of the owl's head. Looking at the bird face on, the right ear lies at seven o'clock and the left at two o'clock. Amazingly, this difference in the location of the two ear openings is reflected in the skull. In other words, the skull is asymmetrically designed. There are other owls whose ear openings are positioned asymmetrically, yet the skull is quite symmetrical and unmodified. The Northern Saw-whet Owl *Aegolius acadicus* also has asymmetrically placed ear openings on its skull, but the other way round to the Great Grey Owl: at ten o'clock on the right and four o'clock on the left-hand side (again looking face on; fig. 4).

Why have asymmetrical ears? The reason is that it maximises the distance between them, which means either that the sound reaches the two ears at very slightly different times, or that the sound is perceived differently by the two ears. It is these differences that allow the owl to pinpoint the sound of an invisible mouse and swoop down and plunge through the snow onto its prey.

Our heads are large enough that sound reaches our two ears at very slightly different times, and allows us to judge where a sound is coming from (albeit much less well than a

Great Grey Owl). How then do tiny birds like Goldcrests tell where sound is coming from? They do this by continually being on the move, which is another way of making sure sound reach the two ears at different times.

Smell

Back in the 1970s, Florentino Papi, an Italian ornithologist, published a paper suggesting that homing pigeons found their way by using their sense of smell. The bird-navigation community was incensed: Papi was virtually unknown as a researcher and everyone 'knew' that birds had no

sense of smell. His research was clearly nonsense. The controversy rumbled on for many years, but we should ask why there was such reluctance to entertain the idea that birds might use olfaction to find their way about.

The idea that birds had no real sense of smell has its origins in some 'experiments' conducted by that famous cocky American bird artist and field ornithologist John James Audubon in the early 1800s. Even at that time there was controversy, but Audubon – mainly through force of personality – managed to persuade most ornithologists that birds had no sense of smell. The idea was reinforced by the fact that birds have 'unexpressive' faces. If we encounter something distastefully smelly, we draw away with a wrinkled nose: no-one recorded seeing such behaviour in birds. Similarly, if we – or our dogs and cats – like the smell of something, we very obviously sniff at it: again nothing much like that occurs in birds.

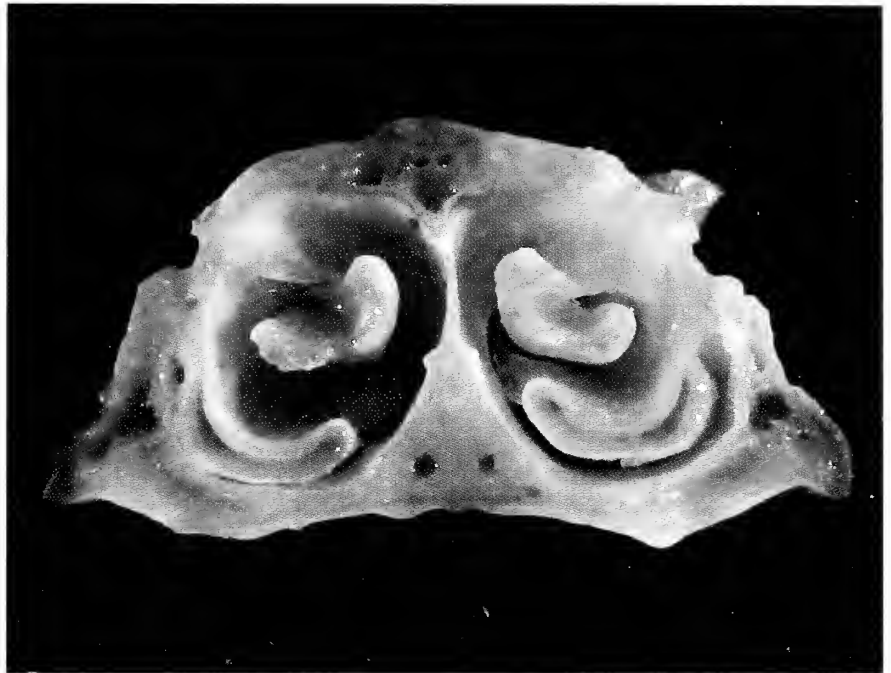
There was, however, one exception: kiwis. In around 1800, and not long after the discovery of the first kiwi, a specimen was sent to Richard Owen in London. Owen was a particularly unpleasant person – he was Darwin's nemesis, but he was also Britain's top zoological anatomist. He recognised immediately just how bizarre the kiwi was. He also speculated that it had an excellent sense of smell, based on the fact that its nostrils were located at the tip of its beak (rather

than at the base), and its brain had a huge olfactory bulb – the region responsible for processing olfactory information. Like many New Zealand birds, Kiwis are flightless, but they are also nocturnal and, in contrast to most nocturnal birds, such as owls, they have appalling eyesight. And what's more... they sniffed and snuffled as they plodded along in the undergrowth. In 1900, W. B. Bentham of Otago University asked Richard Henry, curator of Resolution Island, who had access to a tame kiwi, to conduct some simple experiments to test the kiwi's sense of smell. The results were clear-cut: the kiwi has an *excellent* sense of smell.

But that was it. The kiwi was placed – metaphorically speaking – in a separate box from all other birds. In fact, it was almost an honorary mammal. And just because the kiwi has a sense of smell, it didn't mean that anyone should change their mind about every other bird. Ornithology therefore continued in the belief that birds (in general) have no olfactory sense.

There were anecdotes that suggested otherwise: Common Ravens *Corvus corax* following a coffin containing a child across the moors; Turkey Vultures *Cathartes aura* queuing up on the roof in a house in Jamaica where a man had died; shearwaters and storm-petrels appearing out of nowhere after bits of oily liver had been thrown on the sea by whaling boats; Green Sandpipers *Tringa ochropus* appearing out of nowhere when muddy Norfolk drains were being cleaned out. But they were all ignored.

Then, in the 1950s, a lady by the name of Betsy Bang – a medical illustrator at John Hopkins University – made a perceptive observation. She was helping her husband, who studied respiratory diseases in birds, by drawing the internal structure of the base of the beak, where scroll-like structures are referred to as the nasal conchae (fig. 5, plate



100. The nasal conchae of a Zebra Finch *Taeniopygia guttata*.

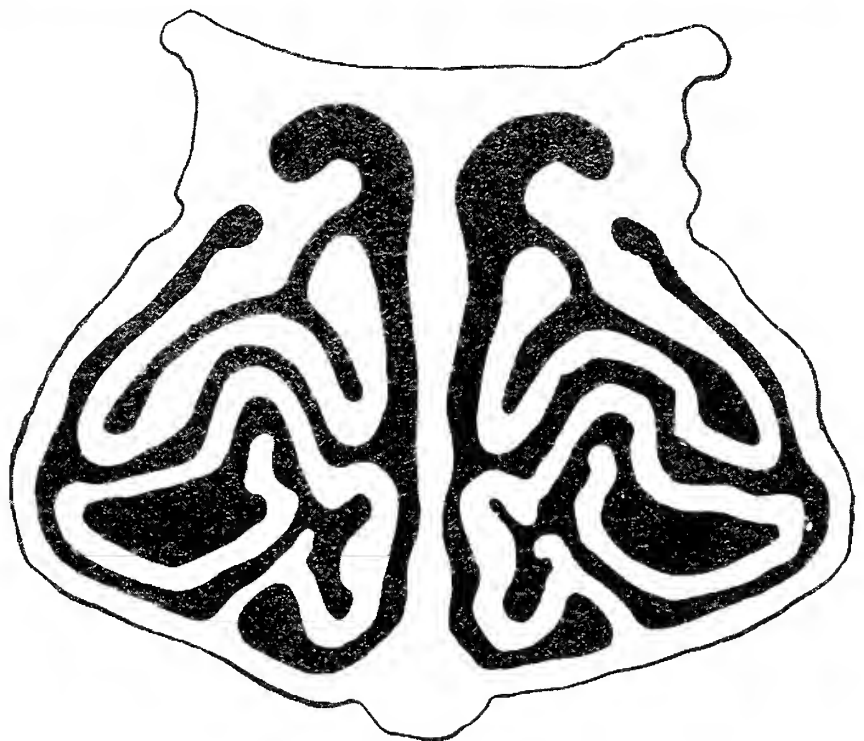


Fig. 5. Drawing of the nasal conchae of a kiwi (from Birkhead 2012, p. 128).

100). The base of our nose is similar. Betsy Bang noticed that the complexity of the nasal conchae varied considerably between species and were more complex – more like a Swiss roll – in species like the Turkey Vulture, albatrosses (Diomedidae) and the Oilbird *Steatornis caripensis*, which it was thought might have a sense of smell. She published a paper, her first, in the journal *Nature* (Bang 1960), and in doing so launched the beginning of a new attitude towards birds and smell.

The difficulty with nasal conchae was that it was hard to quantify the degree of complexity; it was all a bit subjective. Then one evening in the late 1960s, she and her

husband were invited out to dinner. Betsy sat next to the eminent, retired neuropsychiatrist Stanley Cobb, who it turned out studied birds' brains in his spare time. Bang told Cobb about her findings and he told her that there was almost certainly an association between the complexity of the nasal conchae – where smells were detected – and the size of the olfactory bulb, where those olfactory signals were processed in the brain. They made measurements using museum specimens of over 100 species and found it to be true (Bang & Cobb 1968). This meant that the relative size of the olfactory bulb was a reasonable indicator of how important a sense of smell was. In the Turkey Vulture, albatrosses, shearwaters, the Oilbird, and several others the olfactory bulb was relatively large.

A correlation like that gets you only so far, and some experiments were needed. Ken Stager was a museum curator at a zoology museum in California and he decided to repeat and refine Audubon's experiments on Turkey Vultures to assess more accurately whether they had a sense of smell. The results were straightforward: when Stager blew air over animal carcasses out over the green rolling hills of California, the Turkey Vultures came cruising in towards the smell. When he simply blew air with no carcass, they didn't.

One of the results from Bang and Cobb's study was that passerines, especially small ones, have only very small olfactory bulbs,

suggesting that they have only a poor sense of smell. The only snippet of olfactory folklore that suggested that small birds do have some sense of smell was that Blue Tits in Norfolk were known locally as 'pickcheese' – for their habit of entering dairies and eating cheese – presumably because they could smell it.

Some recent results, however, indicate that Great Tits have a much better sense of smell than we ever imagined. It now appears that Great Tits can find trees with defoliating caterpillars (their main prey during the breeding season) by smell. The way this works is remarkable. When the leaves of trees are attacked and eaten by caterpillars, this triggers a defensive reaction by the tree – which releases volatile chemicals from the leaves to deter the insects and thus minimise damage to the leaves. Experiments conducted by a group of Dutch researchers showed that apple trees attacked by Winter Moth *Operophtera brumata* larvae released chemicals that attracted Great Tits, which in turn ate the caterpillars. They also showed that the Great Tits found caterpillar-infested trees by smell alone (Amos *et al.* 2013).

Why is there a discrepancy between Bang and Cobb's olfactory bulb estimate and the ability of Great Tits to smell plant volatiles? One answer is that it is hard to measure the olfactory bulb accurately. Bang and Cobb knew this when they made their measurements: they didn't want to dissect and hence damage the museum brain specimens, so

they used a very simple index of bulb size – its maximum length divided by the maximum length of the rest of the brain. They knew it was crude, and said so in their paper. Length may simply not capture the full size of the bulb very well. We now know that this is true in kiwis, where 3-D imaging by Jeremy Corfield and colleagues has revealed that the olfactory region of the brain is even larger than was once thought (fig. 6). What this means, of course, is that we need

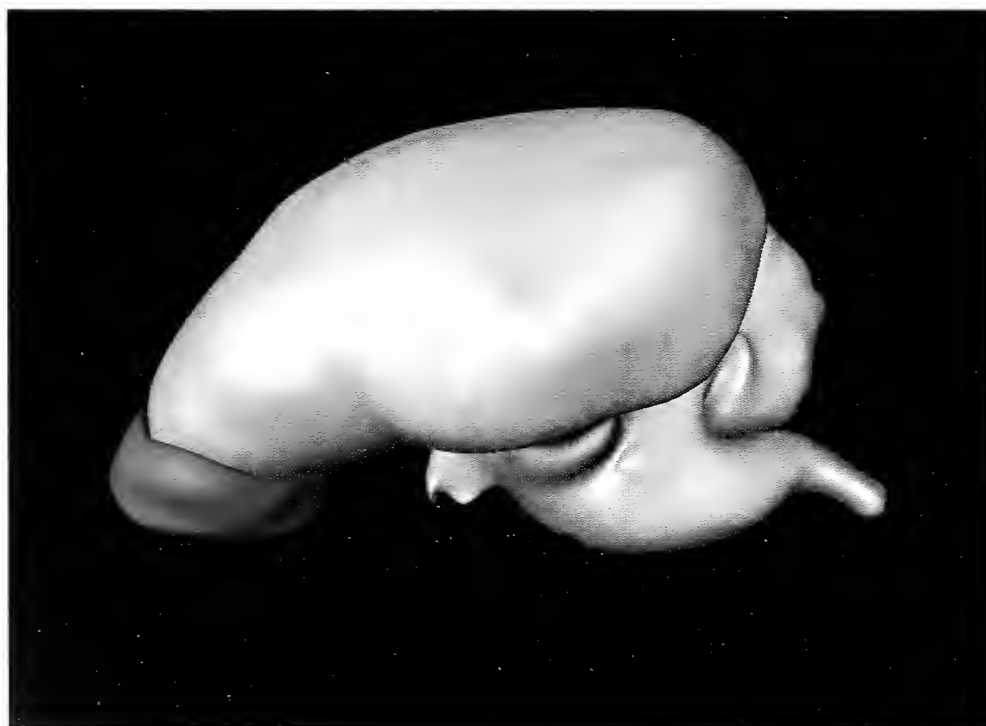


Fig. 6. A 3-D representation of a kiwi brain, showing the olfactory bulb in red (reproduced from Corfield *et al.* 2008, with permission).

to use this sophisticated imaging to obtain a better measure of that region of the brain responsible for olfaction for all the hundred or so species measured by Bang and Cobb (Corfield *et al.* 2008; Cunningham *et al.* 2013).

And what of Papi's pigeons? The enormous growth in olfaction research and the overwhelming evidence we now have that many birds actually have a rather sophisticated sense of smell has vindicated Papi. Moreover, detailed studies by his colleague Anna Gagliardo provide experimental support for the idea that pigeons – and probably other birds too – can use their sense of smell to navigate (Gagliardo *et al.* 2009).

I have considered here only a handful of the senses that birds use to interpret their world. There are many others, including touch, taste, and the magnetic sense, which I discuss in *Bird Sense*. It was once thought that it was impossible to know what it is like to be another species, but we now have enough information, from a variety of different approaches – behavioural, anatomical, physiological and molecular – that we can appreciate that being a bird is much more sophisticated than we ever imagined. From a scientist's point of view, birds provide a marvellous set of opportunities for further research into the senses. From a birdwatcher's point of view, knowing about the remarkable sensory world of birds makes us appreciate them more than ever before, and gives us another reason for wanting to conserve them in all their remarkable diversity.

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Spring migration routes of Long-tailed Skuas around and across the UK – results of observational and tracking data

Rich Johnson



Abstract In 2013 a record spring passage of Long-tailed Skuas *Stercorarius longicaudus* was observed in Scotland, including an unprecedented overland movement. Tracking data for the species has also hinted at overland migration in Scotland. Here, the tracking data are reviewed and the spring passage status of Long-tailed Skuas in the UK assessed, with a particular focus on observed overland movements, and first-hand accounts of major movements in spring 2013.

Introduction

In spring 2013 a record spring passage of Long-tailed Skuas *Stercorarius longicaudus* was observed in Scotland (Rabbitts & Rivers 2013). An unprecedented overland movement in that year was of particular interest given that geolocator tracking data had also hinted at overland migration of this species in Scotland in spring 2011 (Gilg *et al.* 2013). We review the tracking data and assess the spring passage status of Long-tailed Skua in the UK, with a particular focus on observed overland movements.

Summary of geolocator tracking results

As described by Gilg *et al.* (2013), 15 adult Long-tailed Skuas were tagged with light-logging geolocators in 2010–11 at breeding sites in Svalbard (six birds) and northeast Greenland (nine birds). All 15 returned to

their breeding grounds the following summer, and nine were recaptured (six from Svalbard and three from Greenland). Eight of the geolocators were recovered; these provided two geographic locations per day, with an average error of 150–200 km (except during equinox periods and at high latitude in summer, when latitude and/or longitude cannot be calculated).

For those eight birds, the average date for beginning spring migration from wintering areas off southern and western Africa was 21st March, while the earliest estimated arrival on the breeding grounds was in late May/early June. Mean daily rates of travel in spring were in the region of 200 km per day in May – lower than the peak of 345 km per day during autumn migration. All the tracked individuals followed a highly pelagic flyway during their northbound spring migration, before turning east/northeast and

passing relatively close to the northwest coasts of Ireland and Scotland. However, there was tentative evidence that one individual (a male from Svalbard) may have migrated overland across northern Scotland (fig. 1). The straight-line track between the two recovered geolocator points west of Ireland and the outermost Moray Firth would have seen this bird move northeast across the Scottish mainland between 27th and 28th May 2011. Although this result is based on only one bird and two individual data points (with an error of 150–200 km), it corresponds to a period in late May 2011 when record numbers of Long-tailed Skuas were observed passing overland across northern Britain (see below).

Observations of Long-tailed Skuas on spring migration in the UK

Before the late 1970s, Long-tailed Skuas were recorded relatively infrequently in the UK in spring (see, for example, Sharrock 1974) and the species was still sufficiently rare to be considered by BBRC up to 1979. A regular spring passage through UK waters was discovered first in the late 1970s, largely as a result of regular seawatching from the Outer Hebrides (Davenport 1979). The premier site is Aird an Rùnaire (Balranald) on North Uist (table 1; Davenport 1979, 1991; Darlaston 2012), and spring totals of birds moving north there have exceeded 500 in at

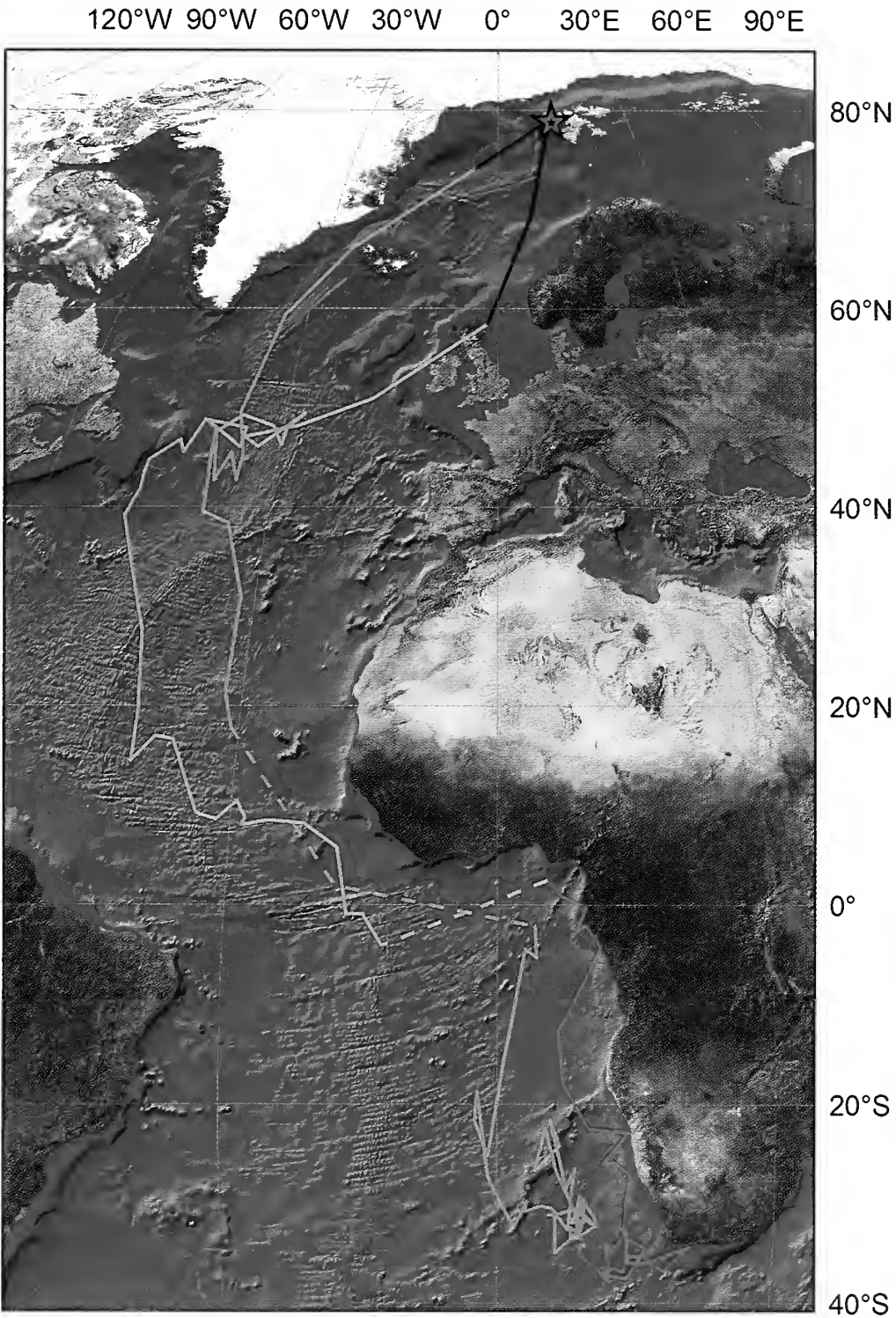


Fig. 1. Flyways used by a male Long-tailed Skua *Stercorarius longicaudus* in 2010–11 between the Svalbard breeding grounds (red star) and the wintering grounds off southwest Africa. Spring movements (April–May 2011) are in yellow, autumn movements (August–November 2010) are in green and winter movements (December 2010 to March 2011) are in red. Dashed lines represent interpolations (linear or parallel to the continents) for periods (equinoxes) when latitude could not be estimated. Black lines represent the same interpolations close to breeding grounds when permanent daylight made estimations impossible. Modified from Gilg *et al.* (2013).

least four years (with a peak of 1,398 in 1991). Significant movements have also been recorded elsewhere in the Outer Hebrides (from Lewis and South Uist) and, since 2006, large numbers have been recorded sporadically from Saltcoats, Ayrshire, and Bowness-on-Solway, Cumbria (table 1). The total passage of Long-tailed Skuas observed in the coastal waters of Scotland each spring is now

Table 1. Peak spring day counts of Long-tailed Skuas in the UK, 2000–12. All counts of ≥ 100 are shown. Note the restricted date range, with all listed counts during 13th–29th May. Data from county reports, BirdTrack/BirdGuides and Darlaston (2012).

Site	Date	Count
Saltcoats, Ayrshire	24/05/2011	600
Aird an Rùnair, North Uist	13/05/2012	550
Aird an Rùnair, North Uist	25/05/2002	460
Saltcoats, Ayrshire	23/05/2011	398
Aird an Rùnair, North Uist	18/05/2007	336
Aird an Rùnair, North Uist	24/05/2011	296
Aird an Rùnair, North Uist	23/05/2009	295
Aird an Rùnair, North Uist	18/05/2004	209
Saltcoats, Ayrshire	16/05/2011	185
Aird an Rùnair, North Uist	28/05/2011	174+
Saltcoats, Ayrshire	24/05/2006	173
Aird an Rùnair, North Uist	18/05/2001	166
Mangurstadh, Lewis	22/05/2006	163
Aird an Rùnair, North Uist	18/05/2002	161
Rubha Ardvule, South Uist	29/05/2011	152
Bowness-on-Solway, Cumbria	29/05/2011	120
Aird an Rùnair, North Uist	19/05/2007	117
Ardivachar Point, South Uist	13/05/2012	100

typically in the range of 100–1,600 birds, with variation as a result of prevailing weather conditions during peak passage periods (Forrester *et al.* 2007). Vessel-based observations confirm that spring migration of this species can occur far offshore from northwest Scotland, for example over the deep waters of the Faeroe–Shetland Channel (Pollock *et al.* 2000). In contrast, very few are recorded in spring from southern and eastern coasts of the UK (Brown & Grice 2005);

geolocator data also suggest that tracked birds do not pass close to southern Britain (Gilg *et al.* 2013).

The observations from Saltcoats and Bowness-on-Solway typically involve birds moving east or northeast overland (e.g. Byars *et al.* 2009). The largest movement at both sites occurred in May 2011, with a total of 1,235 at Saltcoats (including an estimated 1,000 birds on 23rd–24th May). A total of 200 were seen at Bowness-on-Solway, including 63 on 23rd May and 120 on 29th May (the latter including a single flock of at least 100 birds).

Long-tailed Skua passage in spring 2013

Rabbitts & Rivers (2013) gave a detailed summary of the record passage in spring 2013 in Scotland. Peak passage occurred during 20th–23rd May, with three-figure counts from the Outer Hebrides on all four dates. The largest movements were of 1,365 past Aird an

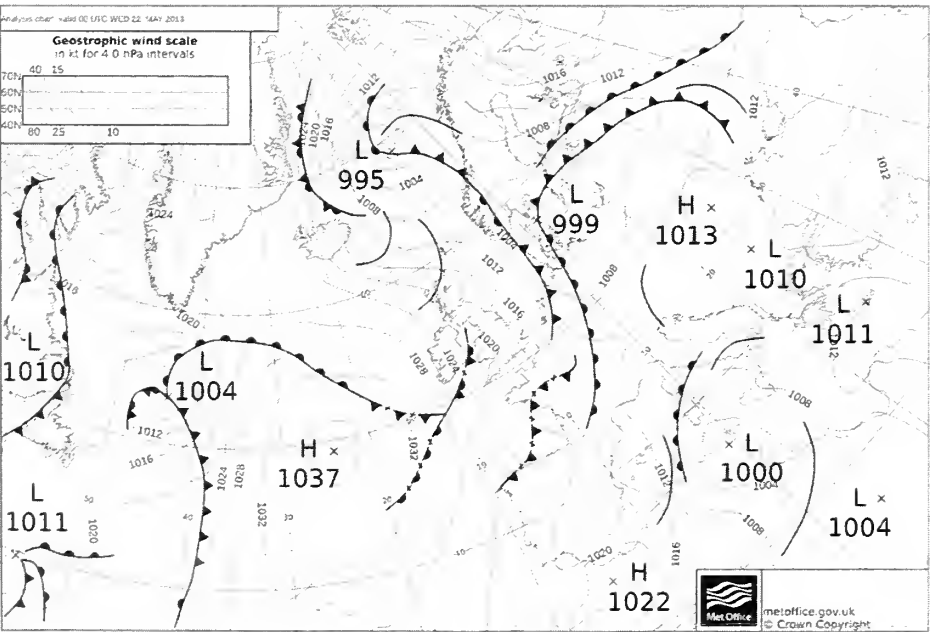
Rùnair on 22nd May, 1,084 over Corran Narrows, Highland, on 23rd and 542 past Westray, Orkney, also on 23rd May. Further details and observer accounts of the movement during these two days are given here.

22nd May 2013

Low pressure to the northeast of Iceland and a large anticyclone over the North Atlantic produced a vigorous WNW airflow across the northern half of the UK on 22nd May (fig. 2).

The peak movement of Long-tailed Skuas at Aird an Rùnair occurred in a 2.5-hour period in the late afternoon and was observed by GT:

At about 15.45 hrs I began to walk out to the headland, where I found another birder shouting and pointing up into the sky towards Balranald RSPB reserve. His excitement was justified, as the distant flock of 250 birds heading high overland were all Long-tailed Skuas! I scoped them until





Gavin Thomas

101. Part of a flock of 85 Long-tailed Skuas *Stercorarius longicaudus* passing Aird an Rùnair, North Uist, on 22nd May 2013.

they were dots heading northeast overland. Staggered by what I'd just witnessed, I joined a couple of other birders in a sheltered spot below the dunes and began to scan over the sea. The wind was NW F6–7 and the weather clear and sunny with good visibility broken only by infrequent squally showers. A second flock, of 85 Long-tailed Skuas, came through shortly after, at 16.05, again cutting across the headland but this time much lower (plate 101).

Further flocks of 200 then 30 were subsequently picked up coming in low over the sea, circling and gaining height before heading off northeast, high overland. Some birds also came through low, however, cutting across the headland and giving superb, close-range (if very fast fly-by) views, low over the machair. The birds in the vanguard of the final, sensational, flock began to come through at 17.55, a staggering 460 birds in total, most of which abandoned their attempt to cut over land and kept heading low and north over the sea, probably 'grounded' by an incoming particularly heavy squall. With the Monach Islands as a backdrop, I tried to count them as accurately as I could as they streamed through my scope view in a seemingly endless line. Since they

were keeping very low, it seems likely some were missed in the wave troughs and it didn't help that at the same time another flock of 100 flew past at close range over land! All the flocks were very quick to move through, no doubt aided by the blustery conditions and desire to press on north.

Smaller numbers were seen elsewhere in the Outer Hebrides, including 105 at Rubha Ardvule, South Uist, and c. 350 off Mangersta, Lewis. However, few were seen away from the Outer Hebrides, with 61 at Saltcoats the only other count of more than 50 (Rabbitts & Rivers 2013).

23rd May 2013

A slight northwards extension of the high-pressure system over the North Atlantic led to a subtle shift in the isobars and a change in wind direction to NNW over northern Britain on 23rd May (fig. 3).

The effect of this headwind on migrating Long-tailed Skuas was immediate and led to large numbers of birds cutting overland along the Great Glen fault line. Running southwest to northeast, the Great Glen is one of Britain's most obvious and impressive landscape features. The fault line runs north-

east from Mull and the adjacent Firth of Lorne along a broad trough (containing Loch Linnhe and Loch Ness), before opening out into the Moray Firth beyond Inverness. The

Corran Narrows (NN017635) is a ‘pinch point’ within Loch Linnhe where the loch is only 250 m wide. DB was at Corran Narrows on 23rd May:

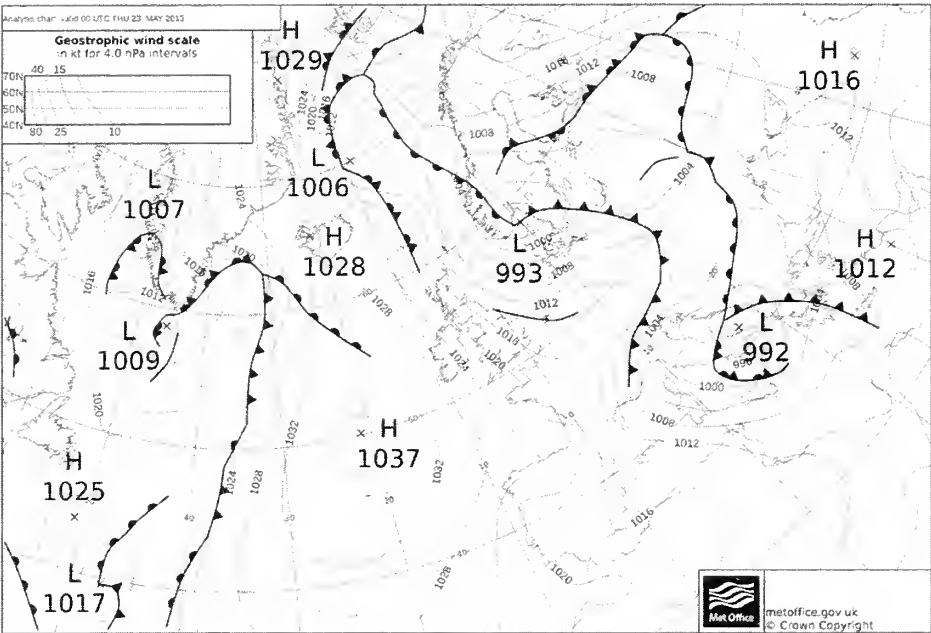


Fig. 3. North Atlantic surface pressure chart for 00.00 hrs on 23rd May 2013 (UK Met Office).



102. Long-tailed Skuas *Stercorarius longicaudus* passing eastwards high over Corran Narrows on 23rd May 2013.

I arrived at Corran Narrows at 14.50 hrs, and within five minutes recognised the distinctive ‘Mexican-wave’ action of a migrating flock of Long-tailed Skuas, approximately 6 km down the loch to the southwest. This materialised into a group of 96 adults that started circling up into the sky about 2 km southwest of the narrows and, at roughly 350 m altitude, progressed northeast inland along the eastern edge of Loch Linnhe. By 17.25 hrs, a total of 607 Long-tailed Skuas had passed northeast over my vantage point in similar fashion, and a scan down Loch Linnhe revealed a further 500 birds heading towards me in a single flock! These birds settled on the water about 7 km southwest of the vantage point; over the next 90 minutes smaller flocks broke away from the main loafing flock and continued to migrate northeast through the narrows. By 18.50 hrs a total of 834 adult Long-tailed Skuas had passed over, with a further 270 presumed still present further down Loch Linnhe making a minimum total of 1,104 during the four-hour observation period. (Rabbitts & Rivers (2013) noted that 250 passed through later that evening.) Flock size varied and was recorded as follows: 96, 31, 16, 10, 15, 28, 75, 146, 160, 20, 10, (flock of 500 on water), 55, 18, 22, 48, 11, 26, 18, 7, 3, 3, 16.

As the afternoon progressed, there was an increase in both the distance from the

Dan Brown

Corran Narrows at which birds started circling up and the altitude that they reached before continuing northeast. For the first two hours, birds were easily visible with the naked eye (plate 102). However, for the last hour almost all birds were either invisible or particularly difficult to detect with the naked eye as they passed overhead. Given the height of the surrounding hills and the use of the summits by Lesser Black-backed Gulls *Larus fuscus* (used as a guide to scale), it was estimated that many skuas were migrating at an altitude of 500–700 m and some possibly higher (one flock of Arctic Skuas *S. parasiticus* was thought to be at approximately 1,000 m altitude). At this height, the horizon would be over 100 km away, so it may have been possible for migrating skuas to see the Moray Firth. Long-tailed Skuas predominated, although a total of six Great Skuas *S. skua*, 15 Arctic Skuas and 19 Pomarine Skuas *S. pomarinus* were also logged, either as single birds or as small flocks of up to seven.

Farther north, RW observed a large coastal Long-tailed Skua passage from Noup Head, Westray, at the northwest tip of the Orkney archipelago:

I settled in at Noup Head at 10.00 hrs, and for the following 7.5 hrs enjoyed one of my most memorable birding experiences ever. Winds were from the NNW and gusting to 45 mph, and this pushed migrating Long-tailed Skuas closer inshore than on the previous two days when winds were from the NW (plate 103). A total of 547 Long-tailed Skuas were recorded moving north, and the hourly totals from 10.00 hrs were 68, 72, 67, 169, 104, 28, 29, 10, with the peak passage in the early afternoon including a long loose flock of 91

birds! The migrating flocks hugged the wave troughs and, once past Noup Head, they pushed on northeast out of sight across the sea.

Elsewhere on 23rd May there were several double-figure counts along the coast of south-west Scotland between Ayrshire and the Inner Hebrides, but nothing close to the numbers seen passing Corran Narrows. Similarly, the Westray counts were almost an order of magnitude higher than any other count from the Northern Isles. Relatively few were seen from the Outer Hebrides, owing to the lack of an onshore component to the wind, with a peak of 242 at Mangersta (Rabbitts & Rivers 2013).

Discussion

The observations in 2013 suggest a significant overland passage of Long-tailed Skuas across northern Britain, associated with strong winds from the west or northwest. The main reason for such overland movements is presumably to conserve energy and/or time in response to certain weather conditions. These data complement earlier seawatching data, which illustrate more conventional (coastal) flyways, while tracking data (summarised above) also hint at overland migration. We combined all these data to create an overview of known and potential Long-tailed Skua migration routes through the UK (fig. 4).



103. Part of a large flock of Long-tailed Skuas *Stercorarius longicaudus* migrating northeast off Noup Head, Westray, Orkney.

Russell Wynn

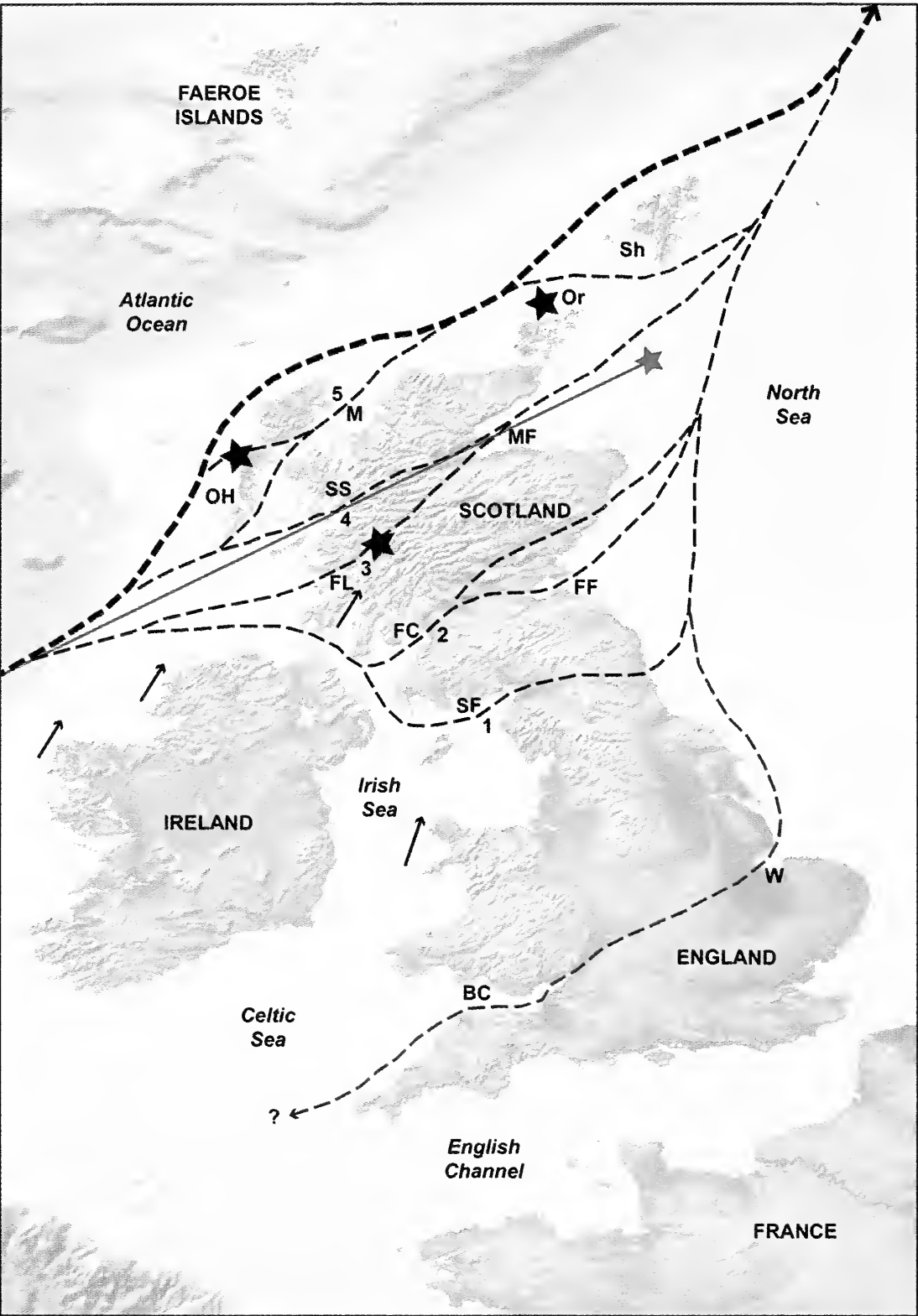


Fig. 4. Map showing spring migration routes of Long-tailed Skuas *Stercorarius longicaudus* across and around the UK, based on data reviewed in this paper. The thick dashed black line shows the coastal flyway for birds moving northeast between the UK and Faeroe Islands, consistent with tracking data and field observations. The thin dashed black lines show alternative overland routes that are used in strong west/northwest winds. Numbers 1–5 represent different flyways: **1** = Solway Firth (SF) to Northumberland via Bowness-on-Solway; **2** = Firth of Clyde (FC) to Firth of Forth (FF) via Saltcoats; **3** = Firth of Lorn (FL) to Moray Firth (MF) via Corran Narrows; **4** = Sound of Sleat (SS) to Moray Firth; **5** = The Minch (M) via the Sound of Harris or the Little Minch. Black stars show locations of Corran Narrows in the Great Glen (flyway 3), Aird an Runair in the Outer Hebrides (OH), and Westray on Orkney (Or). Small black arrows show other potential routes where small numbers of birds are occasionally recorded moving north. Solid red line shows potential track of an adult male Long-tailed Skua between a point west of Ireland on 27th May 2011 and a location in the North Sea on 28th May 2011 (red star). Brown dashed line shows autumn overland route between the Wash (W) and the Bristol Channel (BC). Base map from ETOPO1 (Amante & Eakins 2009).

At a local scale, birds passing along the major coastal flyway to the west of the Outer Hebrides have been seen cutting across relatively small islands such as North Uist, or passing through narrow passages such as the Sound of Harris (flyway 5, fig. 4). This provides temporary shelter from strong headwinds and these birds presumably continue moving north around the west side of Orkney and Shetland. A more significant overland passage runs for 150 km or more southwest–north-east from the coast of southwest Scotland. The three main ‘entry points’ appear to be the Solway Firth (flyway 1), the inner Firth of Clyde (flyway 2), and the Firth of Lorn and Loch Linnhe (flyway 3). Records from spring 2013 also suggest that smaller numbers of birds may head inland at other entry points, for example 39 passing up the Sound of Sleat at Mallaig, Highland, on 22nd–23rd May and 67 perhaps heading towards

the Sound of Sleat via the passage between Rhum and Eigg on 23rd May (flyway 4) (Rabbitts & Rivers 2013). A general lack of records of birds heading north through the Irish Sea, or along the coast of Northern Ireland and through the North Channel (e.g. at Machrihanish on the Kintyre Peninsula), raises the question of where birds moving inland up the Solway Firth have originated. It is possible that they have cut overland across Ireland, possibly from one of the major west-coast embayments (such as Galway Bay or Donegal Bay).

Long-tailed Skuas appear to prefer strength in numbers when passing overland, and typically move in flocks of more than ten (and sometimes more than 100) birds. The largest migrating flocks seem to originate when birds aggregate immediately offshore, before towering up into the sky and departing overland (e.g. Byars *et al.* 2009). Flocks evidently pass high overland at speed; for example, the 1,000 birds moving inland at Saltcoats on 23rd–24th May 2011 failed to generate a single inland or east-coast record. However, the record-breaking movement on 23rd May 2013 did generate a few east-coast sightings. Reports of 29 over Inverness, 14 over Fortrose, seven over Chanonry Point and 18+ passing Fort George in the inner Moray Firth had evidently just exited the Great Glen at Loch Ness (flyway 3). The route taken by a flock of 25 moving north on the same date over Loch of Skene, just west of Aberdeen, is less clear (a further record of 38 NNW over nearby Blackdog on 26th May 2006 might suggest a route tracing the southern edge of the Grampian Mountains, originating at the Firth of Clyde). Otherwise, the only other reports on the east coast of Scotland and northeast England on 23rd–24th May 2013 were all in single figures. It therefore seems likely that the majority of large flocks passing overland do so beyond the sight of observers on the ground, and continue at height as they pass over North Sea coasts and beyond. This is consistent with DB's observations at Corran Narrows on 23rd May 2013 and earlier observations at Saltcoats (Byars *et al.* 2009).

Overland passage of Long-tailed Skuas away from breeding areas is unusual in an international context (see, for example, Wiley

& Lee 1998). Nevertheless, a reverse overland movement has been noted in autumn in northern Britain. McInerny & Griffin (2007) documented a southwesterly overland movement of skuas during 1986–2005 (between late July and mid November), beginning at the Firth of Forth and presumably terminating in the Firth of Clyde (flyway 2). Birds and flocks observed from Hound Point, Lothian, were 'watched at great height and distance moving in a purposeful manner southwest out of view'. However, the Long-tailed Skua was the least numerous of the four skua species recorded, with just 920 noted in the 20-year observation period (compared with 5,501 Arctic, 2,635 Pomarine and 2,099 Great Skuas). Similar observations of autumn skuas have been made in Somerset, relating to birds passing southwest between the Wash and the Bristol Channel (fig. 4). However, Long-tailed Skuas were again far more rarely observed than the other recorded skua species (Thomas 2007), which is perhaps unsurprising given that none of the birds tracked by Gilg *et al.* (2013) passed through the North Sea during autumn migration (most headed west to a staging area at the Grand Banks, Newfoundland).

Conclusions and suggestions for future work

This paper describes several overland spring migration routes for Long-tailed Skuas in northern UK, with the largest movements initiating at major coastal indentations such as the Solway Firth, Firth of Clyde and Firth of Lorn. In some cases the numbers of birds involved can exceed 1,000 per day. More intensive observer coverage at these locations in suitable conditions would provide more detailed insight into overland passage of this and other skua species, particularly in mid and late May when winds are west or north-westerly. Co-ordinated observations at the start and end of the Great Glen flyway would be particularly valuable, as the confining nature of this linear conduit potentially makes it easier to track birds as they move from the west coast to the east coast and beyond.

Other sites that might benefit from increased coverage in suitable conditions include Colonsay and Lismore (relating to

the source of the Great Glen flyway), Mallaig (relating to the source of the Sound of Sleat flyway), Mull of Kintyre (relating to birds passing into the Irish Sea) and elevated locations inland of identified sites of overland passage such as Saltcoats and Corran Narrows. Information on flock altitude during overland movements potentially has practical applications, for example for Environmental Impact Assessments associated with onshore wind turbines that might be sited on adjacent hills, although it is possible that birds pass over too high for conventional observations to be effective and for such potential impacts to be realised.

Acknowledgments

We are grateful to all observers who submitted Long-tailed Skua records to the BirdGuides and BirdTrack databases, allowing them to be analysed for this study. BirdTrack is a partnership of BTO, RSPB, SOC, WOS and BirdWatch Ireland.

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Great White Egrets breeding in Somerset – breeding behaviour in 2013

Following the first successful breeding of Great White Egrets *Ardea alba* in the UK in 2012 (Anderson *et al.* 2013), two pairs bred successfully in Somerset in 2013. The first pair to nest did so in a part of the Shapwick Heath NNR, about 100 m from the nest site of the second of the 2012 nests. The nest was located in a bush in a remote part of the reserve and was almost totally concealed from view. Potential nesting behaviour was first observed in early April, when the birds were seen visiting the site regularly and bringing in nesting material, but close monitoring of this site would have been impossible without revealing its location publicly. Consequently, no formal monitoring programme was initiated. The laying and hatching dates for this nest are not known but two chicks were first observed at the nest on 6th June and by early July both chicks were feeding independently at a nearby lake. No data on the frequency of changeovers during incubation or feeding visits during the post-hatching period are available. One of the parents was CA69229, ringed in Besne, northern France in 2009 (L. Marion pers. comm.), which was one member of the first pair to nest in 2012.

The second pair that nested in 2013 was first seen in an area of the RSPB's Ham Wall reserve on 19th May. The adults were watched returning regularly to a particular location around 1 km from the site of the first nest in 2013, and within 200 m or so of a regular feeding area. Two days later (21st) the birds were seen nest-building. The nest site was visible only from a part of the reserve with no public access, and thus a decision was taken to monitor this nest during daylight hours at least until hatching. The primary objective was protection of the nest from potential egg-collectors and over-enthusiastic photographers but behavioural data were also collected. Formal monitoring began on 29th May and continued until 30th June. The nest was located low down in a bush, at the edge of a small reedbed channel.

It was not possible to see into the nest but, for most of the monitoring period at least, it was possible to detect the presence of an adult on the nest. The exact laying date(s) are not known but were probably during 22nd–28th May. Certainly, when monitoring began on 29th, incubation was underway.

As in 2012, incubation duties were shared by both parents. Changeovers occurred once a day between 29th May and 23rd June with the single exception of 2nd June when two changeovers were recorded (table 1). As in 2012, these changeovers occurred mostly, but not exclusively, in the early morning with an interval of 15–30 hours between shifts, except on 2nd June when an interval of five hours was noted.

During this period of daily changeovers three quite distinct behavioural patterns were observed:

- Up to 5th June, the parent birds greeted each other during changeovers with a neck-stretching display lasting just a few seconds, before the departing bird flew off and the arriving bird settled down into the nest.
- During 6th–15th June, similar greeting behaviour was recorded but the departing adult always returned to the nest site on a number of occasions for up to 90 minutes after the changeover. Almost invariably, the bird returned carrying either a twig or a length of reed, which was presented to the sitting bird, which then arranged it in the nest. These visits typically lasted for just a few seconds. The number of repeat visits varied between 3 and 24, at intervals of 2 to 20 minutes, but no obvious pattern was detectable. However, this behaviour was exhibited by both parents, which contradicts published evidence to suggest that twig passing is carried out only by the male parent (Meyerriecks 1960).
- During 16th–23rd June, daily changeovers continued, still accompanied by the standard greeting behaviour described above. Between changeovers, the attendant bird was observed to stand at frequent

Table 1. Changeover and return flight frequencies at a Great White Egret *Ardea alba* nest in Somerset in 2013.

Date	No. of changeovers	Interval(s) between changeovers (hours)	Return flights: no.	Return flights: period (mins)
29/5	1	unknown	0	–
30/5	1	15	0	–
31/5	1	25	0	–
1/6	1	23	0	–
2/6	2	23	0	–
		5	0	–
3/6	1	27	0	–
4/6	1	17	0	–
5/6	1	25	0	–
6/6	1	26	7	90
7/6	1	22	4	30
8/6	1	30	8	75
9/6	1	18	3	10
10/6	1	28	6	60
11/6	1	21	8	60
12/6	1	25	3	10
13/6	1	25	3	45
14/6	1	27	17	70
15/6	1	20	24	70
16/6	1	27	4	20
17/6	1	24	3	15
18/6	1	24	10	25
19/6	1	19	2	10
20/6	no data	–	–	–
21/6	1	unknown	9	60
22/6	1	25	3	10
23/6	1	22	9	80
24/6	4	23	0	–
		1	2	10
		4	3	30
		2	1	5
25/6	2	18	4	40
		7	0	–
26/6	2	19	6	30*
		8	0	–
27/6	2	16	4	20
		5	0	–
28/6	3	21	9	20
		3	0	–
		3	0	–
29/6	4	16	0	–
		3	0	–
		3	0	–
		4	0	–
30/6	3	15	0	–
		3	0	–
		2	7	30**

* Return visits commenced 3 hrs after changeover.
** Three further return visits over a ten-minute period occurred 3 hrs after changeover.

intervals and often seen to regurgitate, usually followed by a bill-shaking behaviour. We assumed that regurgitation was an indication that hatching had occurred. Return visits to the nest by the departing bird continued to be observed during this period, but in contrast to the behaviour observed in 2012, the returning bird consistently brought reed or twigs to the nest rather than food items. The number of return visits increased dramatically in the two days prior to the first records of regurgitation (14th and 15th), possibly as a response to the eggs hatching.

The first sighting of a chick in the nest came on 16th June and the first suggestion that two chicks might be present was on 19th June (although confirmation of a second chick was not until July 7th and of a third chick not until 19th July) (table 2).

During 24th–30th June, the number of changeovers at the nest increased to 2–4 each day, usually with an interval of at least three hours, and the pattern of return visits after the changeover also varied. On some occasions the relieved bird did not return at all; sometimes return visits continued for up to 40 minutes after the changeover; and on two occasions multiple return visits were made, but not until about three hours after changeover. In all cases reeds or twigs – but not food items – were brought to the nest. However, the attendant adult continued to stand and regurgitate at regular intervals, often to at least two separate places within the nest.

Although formal monitoring ceased after 30th June, the nest was monitored for part of most days until mid August. In contrast to the situation in 2012, when the parents of the two broods started to leave the nest unattended for short periods within 8–15 days after first hatching, and for longer periods within 10–17 days, this nest was constantly attended by one of

the parents until 19th July, about 33–35 days after first hatching (table 2). Initially the attendant parent left the nest but remained within around 50 m of the site, but by the following day the parents were leaving the nest and feeding

approximately 200 m away for short periods. Wing-flapping by the chicks was first noted on 14th July (28–30 days after hatching) and on 15th one of the chicks was seen to walk a metre or so out of the nest. All the chicks remained close to the nest until fledging. The first flight by two chicks was recorded on 12th August, 57–59 days after hatching. This fledging period is similar to that recorded in 2012 for the second nest (57 days) but much longer than the 42-day fledging period given in *BWP*. All three chicks were observed feeding independently on 24th August (69–71 days after hatching). Again this is similar to the period recorded at the second nest in 2012 (62 days) but much longer than the 47 days at the first nest in 2012.

Anderson *et al.* (2013) suggested that the extended fledging period at the second nest in 2012 might have been the consequence of very wet and cold weather during the post-hatching period, which may have limited the availability of food. In 2013, the post-hatching period was very dry and hot and there was no obvious reason why availability of food should have been limiting. However, on both occasions when extended fledging/independent feeding periods were recorded, nesting commenced late in the season. It is also possible that the nesting pair described here was the same pair that occupied nest 2 in 2012.

On a number of occasions, one or more additional adults were recorded visiting the nest site, sometimes perching in the bush immediately above the nest and seemingly studying the activity within. The attendant parent never greeted these visitors and

Table 2. Key nesting events at a Great White Egret *Ardea alba* nest in Somerset in 2013.

	Date	Days from laying (estimated)	Days from first hatching (estimated)
Egg-laying	22–28 May		
Hatching	14–16 June	24–26	
Nest unattended	19 July		33–35
First wing-flapping	14 July		28–30
First movement from nest	15 July		29–31
First fledging	12 Aug		57–59
Independent feeding	24 Aug		69–71

generally seemed to ignore them, but if the non-attendant parent returned, the visitor(s) would often be chased away from the immediate vicinity of the nest. Similar behaviour was recorded at both nests in 2012 and a review of the data revealed that these visits seemed to coincide with key stages of breeding – the laying period and, particularly, at or just prior to hatching. We have found no published record of such behaviour but it may be relevant that the visiting birds were often recorded as having red legs (i.e. also in breeding condition). Similar behaviour has been recorded in France by Loïc Marion (pers. comm.), who suggested that non-breeding birds may investigate nest sites to determine suitability of the habitat for breeding in future years.

Further studies are required to learn more about the behaviour of nesting Great White Egrets in this area. The identification of individual birds would greatly enhance such studies and ringing the fledglings would be invaluable in helping our understanding of dispersal, survival and the potential expansion of the breeding range of Great White Egrets in the UK.

Acknowledgments

We are very grateful to the many dedicated volunteers who together provided more than 800 hours of observation records.

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The ability to hear Goldcrest song and the implications for bird surveys

Richard Porter first raised the issue of deteriorating hearing with age and the possible implications for the results of bird surveys (*Brit. Birds* 105: 152–153). An editorial comment by AM pointed out that there was little data on the subject, and subsequent correspondence followed (see *Brit. Birds* 105: 276–277, 684). While it is well known that, in general, the ability to hear high-frequency sounds declines with age, JT began a survey to determine the precise nature of the problem, specifically related to the ability to hear the song of the Goldcrest *Regulus regulus* as a convenient example.

Respondents to the survey (n=1,056) were not a random sample of the general population. They were birders who replied to the specific question: ‘Can you hear Goldcrest song?’ It is likely that all of them knew the song and were aware of whether they could, or could not, hear it. Respondents were also asked to state their age and gender. Some people suggested why they could no longer hear Goldcrests – for example attending (even performing at) too many pop concerts or having had a career in a noisy industry or in the services. Some commented on the effectiveness of various hearing aids. Gold-

crest song typically includes frequencies of up to 8 kHz, similar to that of Tree Creeper *Certhia familiaris* and Grasshopper Warbler *Locustella naevia*, two other species that respondents often referred to as also troublesome. There is an online hearing test at: www.noiseaddicts.com/2009/03/can-you-hear-this-hearing-test

Data were received from 799 men aged from 15 to 90 and 257 women aged from 20 to 84. Age distributions were similar for each sex with the majority of respondents in their 50s and 60s (quartiles 50/60/67 for men and 50/60/66 for women). The proportion of people of each sex and age who could hear Goldcrests was modelled as a binomial variable, which assumes only that all responses were independent. A wide variety of models were compared using Akaike’s Information Criterion. For men, a broken stick (constant followed by decline from a certain age) model gave the best fit, with the break point optimised at age 42. Overall 83% of males (667/799) could hear Goldcrests but this represents 96% for those in their 40s (and younger) declining to 53% in the 80s. For women, no model was found superior to the null (no change with age), even when

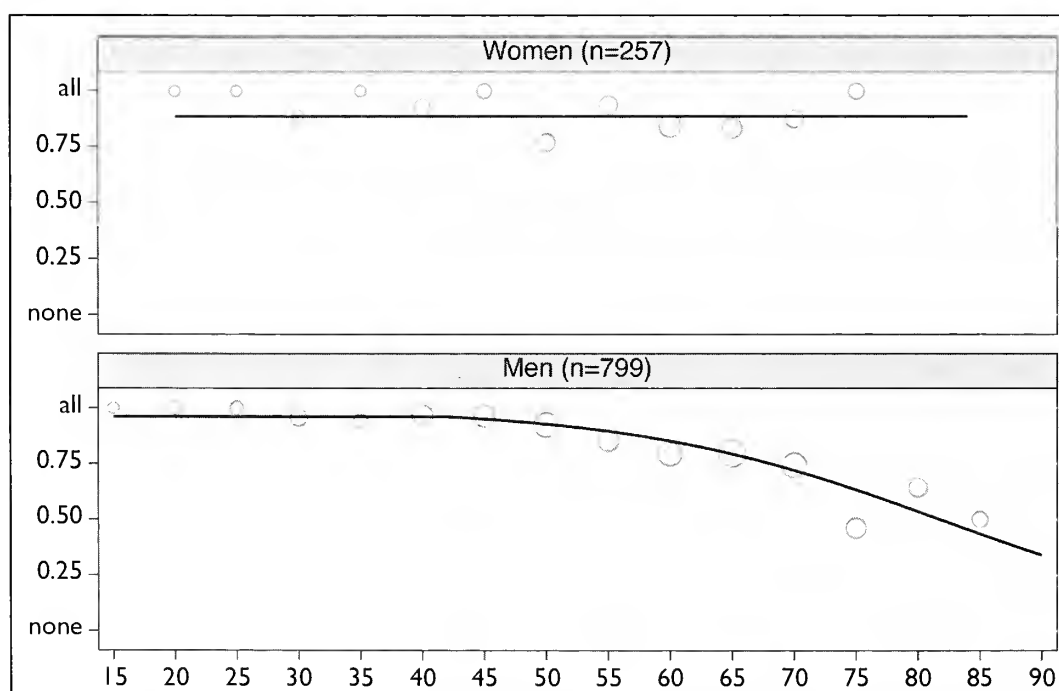


Fig. 1. The proportions of recipients who reported they were able to hear the song of the Goldcrest *Regulus regulus*, plotted against age in five-year bands. Symbol size reflects numbers of respondents.

extreme ages were excluded. Overall 89% (228/257) of females could hear Goldcrests and there is no evidence from this sample of decline with age. Fig. 1 shows the results by five-year age groups and the predictions from the preferred models. The raw data are available in a spreadsheet at www.lanius.org.uk/Goldcrest

In terms of the impact on bird-survey results, the

question of whether – or how – to incorporate the issue of age-related hearing loss is quite a complex one. The BTO doesn't have a full picture of the age-profile of Breeding Bird Survey (BBS) volunteers. The best assessment, albeit based on partial information, is that, over the 20 seasons between 1994 and 2013, the proportion of BBS surveyors in their 30s and 40s has declined, the proportion in their 50s has remained fairly constant, and the proportion in their 60s and 70s has increased.

Is this a cause for concern? That depends on a number of other factors. Firstly, while BBS surveyors are very loyal to the survey, with about 85% retention between years, there is clearly some turnover. If the people who are dropping out are those who are struggling more with their hearing, this would reduce any effect (of the declining ability to hear). Secondly, how many surveyors are countering hearing loss with hearing aids? Thirdly, while the average age of surveyors is increasing, we also know that the proportion of female surveyors is increasing (by about 60% between 1994 and 2013), and the results presented here suggest that this change would lessen the influence of age-related hearing issues to some extent. Finally, the Goldcrest is obviously just one (particularly high-pitched) species among many, and even for a small passerine like this, some individual birds will be detected visu-

ally rather than by song, which would also lessen the issue.

Over the period of the BBS, Goldcrests increased in the 1990s, then remained roughly level for a while before declining in the face of several hard winters. The official overall change statistic is a non-significant decline of -9% for the UK across the period from 1995 to 2011 (Risely *et al.* 2013). The question raised by this survey is to what extent this measure of change might differ if we could remove the effect of age-related hearing loss. This is not something that we are currently able to answer, but our best guess is that the effect would be relatively small, even for the relatively extreme example of the high-pitched Goldcrest.

From the 2014 breeding season onwards, volunteers will have the option to submit additional information on whether they detected birds by song, call or visually while doing their BBS visits. This should help us to understand better the issues relating to differential detectability.

Acknowledgments

We are very grateful to everyone who helped to circulate and replied to the survey.

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Obituary

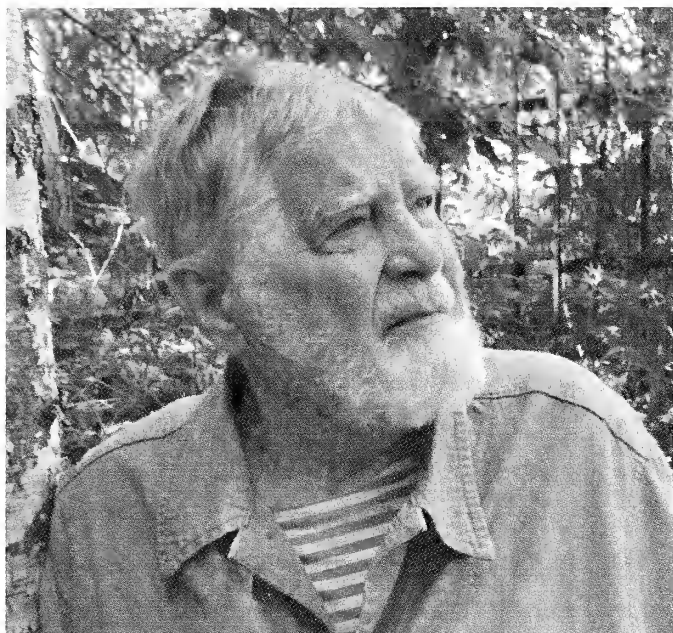
Alexander Kuznetsov (1926–2013)

On 3rd December 2013, Dr Alexander Alexandrovich Kuznetsov passed away in Moscow. He was the last surviving co-author of *A Field Guide to Birds of the USSR*, published originally in Russian, in Moscow in 1968, and then translated into English and published by Princeton University Press in 1984. This book, compiled with Vladimir

Flint (1924–2004), Rurik Boehme (1927–2004) and Yuliy Kostin (1934–1982), was the first field guide to cover all the birds of the former Soviet Union, and remains on sale (and in high demand) today.

Alexander Kuznetsov, born on 18th January 1926 in Moscow, completed his PhD in zoology in 1964, the subject being 'Ornitho-

Igor Balabanoff



104. Alexander Kuznetsov in summer 2009 at his summerhouse, near Moscow.

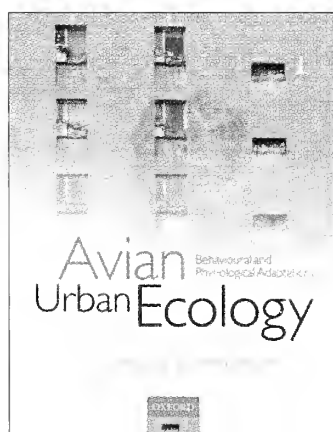
fauna of the Kyrghyz mountains and its structure'. As well as being a prolific ornithological writer, he was known for discovering the first nest of Red-fronted Rosefinch *Carpodacus puniceus* in the former Soviet Union. He was talented in several other fields too: he was a notable figure of Russian literature generally, an actor of some repute (both theatre and cinema) and a mountain man. In 1940, he made his cinematic debut in Lev Kuleshov's

The Siberians; later, he played Boris in Leo Arnshtam's *Zoya* and then a memorable role of a young sailor in Vladimir Braun's *V dal'nem plavanii*. Including a number of key ornithological works, Kuznetsov published more than 50 books (which sold around two million copies), including works of fiction (thrillers and novels) and a series of books of popular science, and he received several literary awards. He was also a Master of Sport of the USSR in alpinism; he made around 100 climbing expeditions among the peaks of the Alps, Caucasus, Tien-Shan, Pamir, Altai and Kamchatka and was the editor in chief of the almanac *Ice and Flame*. During his latter years he devoted much of his time to the history of Russia and was a Vice-President of the Russian Historical Society.

He and his wife, Lidia Nikolaevna, also a veteran of the Second World War and a participant of the Leningrad blockade, celebrated their diamond wedding on 6th May 2009, together with their two children and four grandchildren. His death is a significant loss for Russian ornithology.

Jevgeni Shergalin

Reviews



Avian Urban Ecology: behavioural and physiological adaptations

Edited by Diego Gil and Henrik Brumm

Oxford University Press, 2013

217pp; many black-and-white photographs and illustrations

Hbk ISBN 978-0-199-661572 Subbuteo code M24139

£75.00 **BB Bookshop price** £67.50

Pbk ISBN 978-0-199-661589 Subbuteo code M24136

£37.50 **BB Bookshop price** £33.50

Peregrine Falcons *Falco peregrinus* nesting on city buildings are a recent and well-known urban success story but relatively few birds have adapted to this concrete, noisy and brightly lit environment. In *Avian Urban Ecology* the editors have brought together 27 biologists to review the characteristics that help birds to successfully colonise urbanised areas and the consequences of this lifestyle.

The book is divided into four sections, the first of which is about the pros and cons of urban living, with chapters on the mixed effects of artificial light and of people providing extra food. The second section covers birds' behaviour and physiology in urban environments. A particularly active area of research here is the effect of traffic and other urban noise on bird song. Male Great Tits *Parus major*, for

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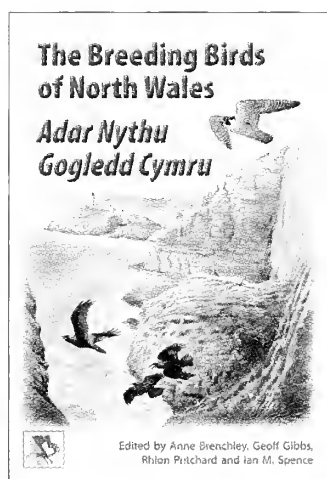
example, sing higher-frequency songs in noisy territories than in quiet ones to make themselves heard better, but possibly at the expense of attracting females, which prefer lower-frequency songs. Genetic and evolutionary changes in urban birds are discussed in the next section. A notable example is the change in the size and shape of the bill of House Finches *Carpodacus mexicanus* over the past 70 years of range expansion in North America. Whereas rural birds eat the soft seeds of grasses and cacti, urban House Finches have longer and deeper bills to cope with the hard sunflower seeds provided in gardens. Other key topics reviewed in the book include the effects of urbanisation on predator avoidance, disease transmission, the timing of breeding and genetic diversity in fragmented populations.

The book finishes with four case studies: how urban Silvereyes *Zosterops lateralis* have changed their songs and calls; how putting up nestboxes

favours Western Bluebirds *Sialia mexicana* at the expense of Mountain Bluebirds *S. currucoides*; the effect noise from a proposed motorway could have on an Austrian population of Stone-curlews *Burhinus oedicnemus*; and how the size of wooded green sites affects numbers of birds breeding in an urban area of Finland.

Each chapter is a self-contained review of the literature or case study, so there is unavoidably some duplication of information and lists of references. The editors have included a short introduction but no overview of the topics covered. The result is an informative collection of articles that will be an important reference and source of inspiration for future research but one that is aimed at professional ornithologists and conservationists rather than more general readers.

Angela Turner



The Breeding Birds of North Wales

Edited by Anne Brenchley, Geoff Gibbs, Rhion Pritchard and Ian M. Spence

Liverpool University Press, 2013

Hbk, 448pp; colour photographs and maps

ISBN 978-1-84631-858-0 Subbuteo code M20995

£45.00 BB Bookshop price £40.00

Over 40 areas of Britain took the opportunity to organise local bird atlases to run in

parallel with *Bird Atlas 2007–11*. One of these was North Wales: the five Watsonian vice-counties of Anglesey, Caernarfon, Denbigh, Flint and Meirionnydd. Together these encompass an area of 6,307 km², or 1,796 tetrads, approximately a third of the area of Wales. Given the large area and the difficult terrain of much of North Wales, this was always going to be a large and daunting undertaking, so Anne Brenchley and her team decided, sensibly, to run a tetrad atlas only in the breeding season, and to continue recording for one extra year. This atlas thus maps the breeding-season distributions of 154 species during 2008–12. The authors did exceptionally well to get this book out little more than a year after fieldwork finished!

So what of the product? First impressions are very good: large, clear maps and well-laid-out pages. This is an almost entirely bilingual atlas too – all the introductory chapters are in both English and Welsh. Each of the species accounts has a summary in Welsh. Not being a Welsh speaker, I can pass no judgement on these, but it is

commendable that efforts have been made to be inclusive in this way.

All species covered get (at least) a double-page spread (Greylag Goose *Anser anser* and Red Kite *Milvus milvus* get four pages) with photograph and text on the left, and maps on the right. The text introduces the birds, describes relevant history and says something about the current breeding distribution, using the maps and occasionally mentioning sites, so this is a good reference for those interested in learning more about birds in North Wales. There are four maps for each species, all clearly showing the relief of the area. The main map, which is about half a page, shows distribution by tetrad, with small black dots showing possible breeding and larger black symbols showing probable (dots) and confirmed breeding (squares). The use of the same size of symbol for both confirmed and probable breeding means that the main breeding range stands out clearly on the map and is a nice way of minimising the impact of fewer records of confirmed breeding, which seems to be a feature of recent atlas fieldwork. For a few species such as gulls, Great Cormorant *Phalacrocorax carbo*, Grey Heron *Ardea cinerea* and Little Egret *Egretta garzetta*, the non-breeding

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distribution is shown by open triangles; these work less well as they become somewhat lost against the greens and browns of the map behind, but they are nevertheless useful in illustrating the range of these species in the spring and summer.

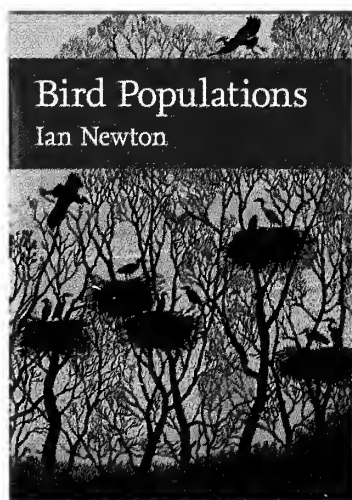
The remaining maps show distribution at the 10-km-square level using data from the first two national atlases and the same data as in the tetrad maps for 2008–12. Rarer species (mainly Schedule 1 but also including Black Grouse *Tetrao tetrix*) do not have a tetrad map, so the 10-km distribution is duplicated and the very large black symbols tend to obscure the background map. The remainder of the map page is taken up with a table showing the number of occupied 10-km squares in the three atlases (split by level of breeding evidence) and tetrad occupancy in 2008–12. These statistics are a useful measure of overall change. Thus Grey Partridge *Perdix perdix* was recorded in only 30.4% of the 10-km squares it occupied in 1968–72, whereas Lesser Whitethroat *Sylvia curruca* now occupies 225%.

The introductory chapters cover details about the project and a summary of the results but it is the long chapter on the habitats, landscape and land use in North Wales which is especially appealing. This chapter is richly illustrated with stunning and

evocative photographs of sites and habitat types, each usually annotated with a comment about typical birds of that place. The reader comes away with a better understanding of the habitats of North Wales at the time of the survey. The results section is focused on conservation issues for Wales such as biodiversity planning and the Welsh conservation status (red, amber or green listing). Seven species groups (waterbirds, seabirds, raptors and owls, waders, upland birds, woodland birds and farmland birds) are analysed separately and composite maps presented which show clearly those areas most important for the particular group. There seems not to be any further analysis of species distributions against habitat features, which can help to explain why species breed where they do – such analysis has been attempted by only a few local atlases. The results are compared with those from previous national atlases, but since this is the first tetrad atlas for the area it breaks new ground in defining just what occurs where.

This book will appeal to anyone addicted to bird atlases but also anyone interested in the birds of Wales.

Mark Holling



Bird Populations

By Ian Newton

Collins (New Naturalist), 2013

596pp; colour photographs and diagrams

Hbk ISBN 978-0-00-742953-0 Subbuteo code M21583

£55.00 BB Bookshop price £49.00

Pbk ISBN 978-0-00-752798-4 Subbuteo code M21584

£35.00 BB Bookshop price £31.00

Everyone has them: the half-dozen or so books that sit on the

desk within easy reach, ready for quick reference as required. Mine are *BWP Concise*, the *Collins Guide* (large format), an atlas, *The Status of Birds in Britain and Ireland*, a couple of statistics books and Ian Newton's incomparable *Population Limitation in Birds*. Since its publication in 1998, this last book has been (for me at least) the 'go to' book when I need to learn about, or check for previous papers published on, a particular ornithological topic.

In many ways, Ian's latest contribution to the New Naturalist series is a successor to that book, providing both an update (over a third of the items in the extensive reference list were published since 1998) and a more discursive account of the factors that limit, regulate and influence bird populations.

It's perhaps worth saying at the outset that this current volume is not a blow-by-blow account of recent (and not-so-recent) changes in the British avifauna, though much of that information is in here. Rather, it explains why and how bird populations change and uses the unparalleled amount of work on Britain's bird populations to assess the influence of different drivers of change. The first chapter, along with some general principles of how populations are regulated, sets these out in brief. Each of the following chapters then deals with a particular cause: food, predation, diseases, hunting, weather, etc. Throughout, Ian is careful to separate effects and impacts; many factors may have a demonstrable effect, but not necessarily an important impact. Thus, for example, while raptors undoubtedly can have an effect on local bird numbers, the evidence for impacts on wider popula-

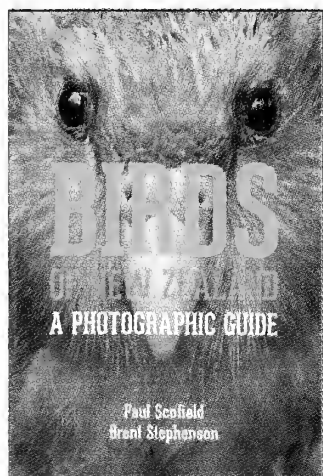
tions is scarcer. Similarly, while hunting clearly also has an effect on autumn numbers, if managed sustainably breeding numbers may not change at all.

Anyone who has read any of Ian's previous books will know what to expect: clear and refreshingly jargon-free explanations backed up by a careful assessment of the evidence. The chapters on predation and hunting, in particular, are especially lucid and should be required reading for anyone interested in these topics. A trademark of Ian's books is his astonishing command of the literature, not just recent papers but also of older (from the 1950s and 60s and even earlier) papers, a resource that younger scientists, too often reliant on internet search engine results, should not forget. Sometimes, though, this mass of detail can make the argument difficult to follow. Despite a liberal use of headings and a 'Concluding Remarks' section to each chapter highlighting the key points to guide the way, at times I came away from this book reeling. This detail is, however, often fascinating and informative. Accounts of the raptors claimed to have been shot on individual Scottish estates in the late nineteenth century (several hundred per year of a dozen or more species), even if exaggerated, give one pause for thought as to what bird densities must have been 150 years ago. These days, we are undoubtedly attempting to conserve a

depauperate fauna, and the next generation will need to have vision if they are not to be limited by that which they have experienced, rather than the vibrant avian communities that previous generations are likely to have enjoyed.

For all the fashionable talk these days of 'ecosystem services' and 'biodiversity', we still need to understand the details of how populations fluctuate if we are to attempt to effectively manage/conservate them; in many ways, this volume provides a handbook to just that. Will it replace my battered copy of *Population Limitation*? Probably not. Although more up to date, it lacks the exhaustive tables and global reach of that more technical tome (not a criticism, just reflective of a different audience), but I suspect that it is not going to be far from my desk. Even better would be a searchable e-book version so that studies pertinent to different species or contexts could be located quickly. Much has been made of the collectable nature of the New Naturalists; pristine copies will no doubt sit on many bookshelves and, in this case, that should be considered a crime. Anyone interested in Britain's bird populations will learn from this book, and I certainly did. This is a book that deserves to become well thumbed and which will repay re-reading many times.

Rob Robinson



Birds of New Zealand: a photographic guide

By Paul Scofield and Brent Stephenson

Yale University Press, 2013

Pbk, 546pp; 1,000+ photographs

ISBN 978-0-300196-82-5 Subbuteo code M24061

£30.00 BB Bookshop price £27.00

A recent survey of regular travellers saw New Zealand voted as the world's best country to visit, and having

visited the country three times, I have to agree that it is a very special place. One can only wonder what it was like before the arrival of humans and the subsequent loss of over 40 endemic bird species.

There are several bird books covering New Zealand on the market already and while most are good, this one raises the bar by several notches, with more than 1,000 photographs to show each species in several plumages and conditions. While Brent Stephenson has co-ordinated the photography for this book, Paul Scofield has crafted much of the text. Both he and Stephenson are seabird fanatics so it comes as no great surprise to discover

that this group has been treated in depth.

Although an 'average' trip to New Zealand will probably yield around 140 species, this book features a total of 365, including all those found on the many islands within the country's nautical boundary. It is quite weighty at 1.2 kg, but I cannot find anything in here that I would want to see left out.

An authoritative text covers identification, separation from similar species, vocalisations, distribution (including a small map), breeding biology, behaviour and taxonomy, with Māori, English and scientific names.

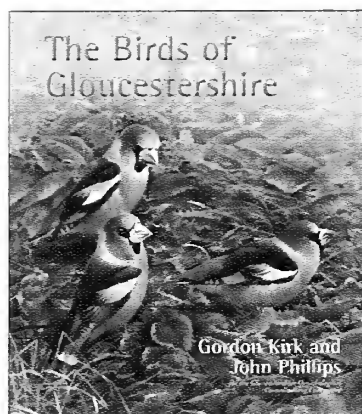
The last five years have seen significant changes in the use of photography in field guides, and this book is a great example of how to use photography at its best.

Keith Betton

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The Birds of Gloucestershire

Gordon Kirk and John Phillips

Liverpool University Press, 2013

Hbk, 452pp; colour photographs, maps and graphs

ISBN 978-1-84631-808-5 Subbuteo code M20995

£45.00 BB Bookshop price £40.00

This new avifauna covers the current bird-recording area

of Gloucestershire (thus excluding the local authority area of South Gloucestershire, which since 1974 has been treated as part of Avon). It is a large-format book, attractive to the eye with its many colour photographs, line-drawings, maps and graphs. The maps were drawn using data from fieldwork for *Bird Atlas 2007–11*. In Gloucestershire, it was decided to visit all tetrads within the county as part of the atlas fieldwork in the four-year period, and to record all birds in both winter and the breeding season. Every tetrad with at least 50% of its land within Gloucestershire was visited, resulting in a truly comprehensive survey.

Rather than produce 'just' a local atlas, the organisers decided to include data on all the species recorded in Gloucestershire, making this the definitive compilation of the birds of the county. As such it is a must-have reference for any birders living in or with a close interest in the county.

I am not particularly familiar with the area but have a keen interest in atlases and avifaunas, so was interested to see how the authors have moulded the sometimes competing objectives of these two formats. The introductory chapters give the background to the project and an overview of the county and its birdlife. There is a history of bird-watching, recording and conservation and a summary of bird surveys in Gloucestershire. The role of the national atlas project and its methodologies are described. These informative reference chapters are well illustrated with habitat photographs, maps and tables.

The species accounts cover 330 wild or naturalised species, plus a summary of BOU category D and E species. Since this is an avifauna, the county list has been reviewed and updated using modern standards of acceptance. Most species warrant a double-page spread, often including a colour photograph and a line illustration on the left-hand side, with four maps and three tables on the right. The tables show the number of tetrads where the species was recorded in the atlas survey, the number of 10-km squares occupied in Gloucester-

shire in all three national atlases, and (where available) UK population trends. Remaining species warrant a text of variable length, summarising the status and historical records. Records of county rarities are up to date to the end of 2011. Some species, such as the skuas, benefit from graphs analysing county records over previous decades and occurrence by month. All species texts include some general information on the species; I would have preferred this space to have been used to offer more interpretation of the maps, analysing why birds occur where they do by comparing distributions to habitat features.

The maps show distribution and abundance (one of each for breeding season and for winter, as appropriate). Symbols are laid across a largely grey background showing relief, with built-up areas in purple. For some resident species, such as Barn *Tyto alba*, Little *Athene noctua* and Tawny Owls *Strix aluco*, where atlas fieldwork is not the best methodology for locating the species, a map of year-round distribution is also included and this is a worthwhile addition. The winter maps use bold dark blue squares (distribution) or circles (abundance) and these are effective in conveying the patterns. Abundances were calculated using the average number of birds encountered per hour during timed tetrad visits and the data divided into four roughly equal-sized groups and displayed using four different dot sizes. Thus Blackbird *Turdus merula*, which was recorded in every tetrad, nevertheless shows clumps of greater abundance. Unfortunately, these are not fully explained in the text (an area of lower abundance in parts of the Cotswolds is, however, mentioned). Breeding-season maps are similar but the distribution maps use different-coloured squares for four levels of breeding evidence (confirmed, probable and possible breeding, or just 'present'). Levels of evidence below confirmed breeding are represented by squares in two shades of orange; tetrads where birds were recorded as present only are represented by an open square. These maps work less well as the overall distribution is not immediately apparent: only tetrads where breeding was confirmed stand out. The abundance maps (four sizes of orange circle) work much better, and some

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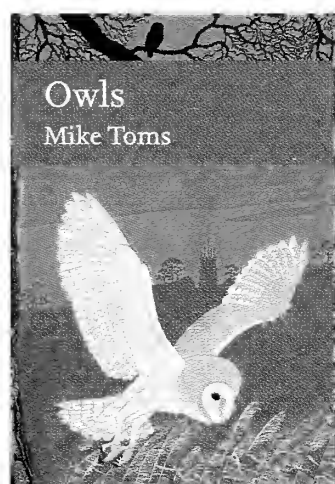


attempt is made to explain the differences, but no data are available to test the hypotheses given. Because this is the first tetrad atlas of the county, there is no opportunity to describe changes at the tetrad level, but perhaps more could have been gleaned from any changes in 10-km-square distributions over the last 40 years, using national atlas data.

The Birds of Gloucestershire works well as an avifauna, and is a solid reference on the occurrence of birds in the county. The inclusion of the atlas

maps really makes a difference, however, providing much more information than would otherwise have been possible, especially for the regularly occurring species. The maps also provide welcome and prompt feedback to the volunteer fieldworkers. Given the fast turnaround from end of fieldwork to publication – a little over two years – the authors should be congratulated in producing such an attractive reference work.

Mark Holling



Owls

By Mike Toms

Collins (New Naturalist), 2014

419pp; colour photographs throughout

Hbk ISBN 978-0-00-742555-6 Subbuteo code M20994

£55.00 BB Bookshop price £49.00

Pbk ISBN 978-0-00-742557-0 Subbuteo code M20995

£35.00 BB Bookshop price £31.00

Although not apparent from the title, this volume is a natural history of the British owls with the focus primarily on our five widespread species. Snowy Owl *Bubo scandiacus* and Eurasian Eagle Owl *Bubo bubo* are also dealt with, and there are very brief accounts for the three species to have made it here as vagrants.

After an excellent opening chapter to introduce the group, there are four extensive chapters reviewing the basic ecology of British owls, covering diet, breeding ecology, movements and threats. A chapter on owls and humans deals with our surprisingly varied and changeable attitudes to this group over the centuries, ending with an overview of recent conservation efforts and prospects for the future. The final chapter takes up about a quarter of the book and provides concise accounts for each of the seven British species, covering identification, status and basic ecology.

In some respects this book has been 70 years in the making. Back in 1943, it was included in a list drawn up by the New Naturalist series editors of 30 or so possible titles. Until now, it was the only one of those titles to have escaped publication. So, has it been worth the wait? The answer is an unequivocal 'yes'. Mike Toms has succeeded admirably in writing a book that is detailed and authoritative

yet, at the same time, accessible and highly enjoyable to read. It has clearly been very thoroughly researched and draws on large numbers of studies published during the last few years. For the relatively well-studied species such as Barn Owl *Tyto alba* and Little Owl *Athene noctua*, where knowledge advances quickly, it is especially useful that the latest research findings are covered fully. The contrast with the far-less-well-studied Short-eared Owl *Asio flammeus* and Long-eared Owls *A. otus* is striking. Despite their popularity with birders, these are difficult birds to get to grips with and our understanding of population size and trends, as well as some of their basic ecology, is clearly far from complete.

The book is superbly illustrated with numerous high-quality colour photographs placed within the text, where they are most relevant. This adds much to the feel of the book and is such an improvement on the still all-too-common practice of having photographs grouped together in blocks of plates. As an up-to-date overview of a popular group of birds, this book is one of the very best of its kind. I would have no hesitation in recommending it both to keen students of owls and to those with a more casual interest who are keen to learn more.

Ian Carter



Recent reports

Compiled by Barry Nightingale and Harry Hussey

This summary of unchecked reports covers the new arrivals in the period from early February to early March 2014.

Headlines In a period largely devoid of exciting new rarities, a Yellow-rumped Warbler in Co. Durham stood out, along with a variety of large gulls, including a Slaty-backed Gull in Co. Galway in February, an American Herring Gull in Argyll and three others in Ireland. New Ross's Gulls appeared in Lancashire & N Merseyside and Glamorgan, while there were no fewer than three in Ireland, and an unseasonal Fea's Petrel flew past Spurn.

Cackling Goose *Branta hutchinsii* Long-stayers: Islay (Argyll), up to three to 27th February, two to 4th March, one to 8th; Ballyconnell (Co. Sligo), to 9th March. **Red-breasted Goose** *Branta ruficollis* Southernness/Mersehead (Dumfries & Galloway) long-stayer to 17th February. **American Wigeon** *Anas americana* Long-stayers in Co. Armagh, Co. Donegal, Gwent, Highland, Co. Leitrim and Orkney. Also: Outer Hebrides, 9th February to 9th March; Cumbria, 22nd February; Co. Sligo, 25th February. **Black Duck** *Anas rubripes* Long-stayers: Loch Sunart/Strontian (Highland), to 7th March; Termoncarragh Lake (Co. Mayo), to 20th February. **Blue-winged Teal** *Anas discors* Saltholme (Cleveland), 11th February; Threave (Dumfries & Galloway), 15th February and 1st March. **Lesser Scaup** *Aythya affinis* Long-stayers: Dozmary Pool (Cornwall), to 9th March; Cosmeston Lake (East Glamorgan), to 16th February; Loch Watten (Highland), to 4th March; Tittesworth Resr (Staffordshire), to 3rd March. Also: South Uist (Outer Hebrides), 9th February; Angliham (Co. Galway), 16th February; Dunfanaghy (Co. Donegal), 18th–26th February; St John's Loch (Highland), 24th February to 1st March. **King Eider** *Somateria spectabilis* Long-stayers: Cahermore (Co. Cork), to 9th March; Ruddon's Point/Largo Bay (Fife), to 9th March (two on 6th); Eyebroughy/Fidra/Gullane Bay (Lothian), two to 16th February, at least one to 9th March; Blacksod (Co. Mayo), to 9th March. Also: Bluemull Sound (Shetland), two, 10th–18th February. **Common Scoter** *Melanitta nigra* Hilbre Island (Cheshire & Wirral), a whopping 27,000 on 3rd March. **Surf Scoter** *Melanitta perspicillata* Long-

stayers in Co. Cork, Denbighshire (up to eight to 9th March), Dorset, Co. Down (to 23rd February when joined by a female) and Outer Hebrides. New arrivals in Co. Clare, Cornwall, Fife, Lothian and Co. Sligo.

White-billed Diver *Gavia adamsii* Off Unst/Fetlar (Shetland), up to three between 7th February and 7th March; Lewis (Outer Hebrides), 7th February; Sandside Bay (Highland), 7th–11th February; Scapa Flow (Orkney), three, 17th February; South Ronaldsay (Orkney), 17th February intermittently to 8th March; Gruinard Bay (Highland), two, 24th February. **Zino's/Fea's Petrel** *Pterodroma madeira/feae* Spurn (Yorkshire), 10th February. Presumed **Chinese Pond Heron** *Ardeola bacchus*, previously reported as Squacco Heron *A. ralloides*, at Saltwood (Kent), present to 8th March. **Cattle Egret** *Bubulcus ibis* Long-stayers: Steeple Claydon (Buckinghamshire), to 24th February; Hillsborough (Co. Down), to 8th March.

Pied-billed Grebe *Podilymbus podiceps* North Uist (Outer Hebrides), long-stayer to 9th March. **Black Kite** *Milvus migrans* Glanmire (Co. Cork), 2nd March. **American Coot** *Fulica americana* Loch Flemington (Highland), long-stayer to 9th March.

American Golden Plover *Pluvialis dominica* Porthgwarra (Cornwall), 1st March. **Lesser Yellowlegs** *Tringa flavipes* Lepe CP (Hampshire), long-stayer to 6th March. **Marsh Sandpiper** *Tringa stagnatilis* North Uist, long-stayer to 9th March. **Long-billed Dowitcher** *Limnodromus scolopaceus* Pennington/Keyhaven Marshes (Hampshire), long-

stayer intermittently to 8th March.

Forster's Tern *Sterna forsteri* Long-stayers: Nimmo's Pier (Co. Galway), to 16th February; Mullet Peninsula (Co. Mayo), to 23rd February. **Bonaparte's Gull** *Chroicocephalus philadelphia* Long-stayers: Dawlish Warren (Devon), to 26th February, and Cardiff (East Glamorgan), sporadically 9th February to 9th March. Also: Thurso (Highland), 25th–27th February; Loch Caolisport (Argyll), 2nd–9th March. **Ross's Gull** *Rhodostethia rosea* Long-stayers: Kinsale (Co. Cork), to 9th March; Ringsend (Co. Dublin), 7th–27th February, presumed same as North Bull in January. Also: Leighton Moss (Lancashire & N Merseyside), 9th February; Aberavon (Glamorgan), 9th–16th February; Lady's Island Lake (Co. Wexford), 20th February. **Laughing Gull** *Larus atricilla* Ballycotton (Co. Cork), long-stayer to 2nd March; Marazion (Cornwall), 17th–19th February. **Franklin's Gull** *Larus pipixcan* Canna (Highland), long-stayer to 20th February. **Slaty-backed Gull** *Larus schistisagus* Galway (Co. Galway), 8th February. **American Herring Gull** *Larus smithsonianus* Campbeltown (Argyll), 15th February to 9th March; Mullet Peninsula, 17th February to 5th March; Cruisetown Strand (Co. Louth), 2nd March; Portmagee (Co. Kerry), 9th March.

Snowy Owl *Bubo scandiacus* Exnaboe (Shetland), 14th February. **Gyr Falcon** *Falco rusticolus* Quarff (Shetland), 27th February.

Penduline Tit *Remiz pendulinus* Dungeness (Kent), two, 15th February to 3rd March, one to 9th; Shapwick Heath (Somerset), 16th February. **Pallas's Leaf Warbler** *Phylloscopus proregulus* Folkestone (Kent), long-stayer to 22nd February; Petersfield (Hampshire), 15th February. **Hume's Warbler** *Phylloscopus humei* Long-stayers: Ramsgate (Kent), Dungeness and Coleshill (Warwickshire), all to 9th March. **Dusky Warbler** *Phylloscopus fuscatus* Great Barr (West Midlands), 25th February

and 4th March. **Red-flanked Bluetail** *Tarsiger cyanurus* Shire Valley (Gloucestershire), long-stayer to 9th March. **Olive-backed Pipit** *Anthus hodgsoni* Leiston (Suffolk), 15th February. **Buff-bellied Pipit** *Anthus rubescens* Burton Marsh (Cheshire & Wirral), long-stayer to 15th February.

Two-barred Crossbill *Loxia leucoptera* Long-stayers: Forest of Dean (Gloucestershire), 12 to 1st March, dwindling to one on 9th; Hemsted Forest (Kent), 19th February and 9th March; Postensplain (Shropshire), three to 24th February; Broomhead Resr (Yorkshire), seven to 2nd March, six to 9th. Also: Broughton (Lincolnshire), 9th February to 9th March; Nercwys Mountain (Denbighshire), three, 17th February; Leith Hill Wood (Surrey), 26th February. **Parrot Crossbill** *Loxia pytyopsittacus* Long-stayers: Holt (Norfolk), up to 16 to 24th February, eight to 8th March; Budby Common (Nottinghamshire), 14 to 10th February; Mayday Farm (Suffolk), 16th February. Also: in Suffolk, King's Forest, 20th February, Ashby Dell, four, 21st February, and Clowes Wood, six, 22nd February, then eight on 23rd; Waveney Forest (Norfolk), 18, 22nd February, eight to 2nd March; Sandy (Bedfordshire), five, 2nd March. **Little Bunting** *Emberiza pusilla* Lea Marsh (Lincolnshire), 28th February to 9th March. **Yellow-rumped Warbler** *Setophaga coronata* High Shincliffe (Co. Durham), 27th January to 16th February.



Simon Knight

105. Yellow-rumped Warbler *Setophaga coronata*, High Shincliffe, Co. Durham, January 2014.

Talking point

A minute's not-so-quiet reflection

The 50th anniversary of the publication in the USA of *Silent Spring* inspired a flurry of headlines and comment in autumn 2012, particularly, of course, in North America, where author Rachel Carson is still widely revered. The publication of this iconic book in the UK came a year later, in 1963, although by then the ripples had already been felt on this side of the Atlantic. Prince Philip is said to have brought advance copies of *Silent Spring* to these shores aboard the royal yacht, so alarmed was he by the insights within it. The words 'silent spring' were quickly ingrained in the public consciousness as the book sold worldwide. I sometimes wonder whether any title, aside from religious texts, has been registered by so many, even those who have never picked up the book.

What's less well remembered about Rachel Carson is an event that gives us a third half-century anniversary, on 14th April 2014. On a calm spring Sunday evening in 1964, in a Maryland town called Silver Spring, Rachel Carson died. She had lived barely 18 months beyond publication of her world-changing book; long enough to witness its extraordinary initial impact, and to weather the extreme backlash it provoked from sections of industry and the scientific community. And long enough to be vindicated by President Kennedy's Scientific Advisory Committee, specially appointed to examine the validity of the issues 'Miss Carson' had raised and exposed.

CBS broadcast a special programme when that Committee released its findings. 'Miss Rachel Carson had two immediate aims,' it declared. 'One was to alert the public; the second, to build a fire under the Government. She accomplished the first aim months ago. Tonight's report by the Presidential panel is prima facie evidence that she has accomplished the second.'

'The report has vindicated me and my principal contentions,' Carson responded. 'I am particularly pleased by the reiteration of the fact that the public is entitled to the facts... My reason for writing *Silent Spring*.'

People are usually surprised to discover that Rachel Carson died so soon after *Silent Spring*, that she didn't live to see the later impacts of its message – the banning of agrochemicals such as aldrin, dieldrin and heptachlor, the setting up of the Environmental Investigations Agency, and the

withdrawal of DDT from the USA a decade on, and later (as well as sooner) elsewhere. People were also shocked by Carson's death at the time. In fact she had been battling illness for a substantial part of the four and half years it took to research and write *Silent Spring*. Towards the end she was often in extreme discomfort. She kept secret her illness primarily because she was sure her opponents – the ranks of vested interest profiting from the 'war on nature' being waged at the time through indiscriminate 'biocide' use – would use it to undermine her still further, to question her motives and her objectivity.

Rachel Carson had cancer. It has never been suggested – and certainly not by the author herself – that her condition was linked to agrochemical excesses. How could it be, any more than any individual case can be attributed to ambient toxins. But dying she most certainly was, and she bore this with the same quiet, stoic dignity that characterised all her public appearances and utterances. She was a courageous and extraordinarily resilient person, who overcame all the obstacles placed in the path of women wishing to train as scientists. She adopted and raised her orphaned grand-nephew, and was a carer and provider for older relatives too. Through the success of a trilogy of books on the marine environment she achieved financial independence, which made the *Silent Spring* project possible, despite everything. She retired from government service to work on the book, to bring the facts together and raise the alarm, knowing that government would not – or could not – do the job itself.

If it were up to me, 14th April would be officially designated as Rachel Carson Day. We wouldn't mark it each year with a minute's silence, or even a minute's applause; I'd advocate a minute's birdsong – ideally the real thing.

Conor Jameson

Conor's latest book, *Shrewdunnit*, is published this month, by Pelagic.

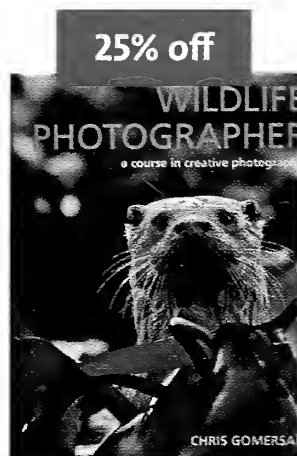
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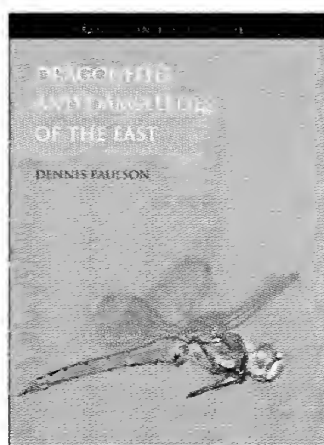
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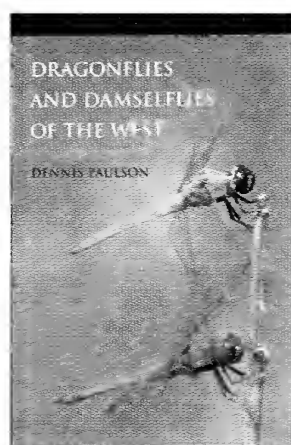


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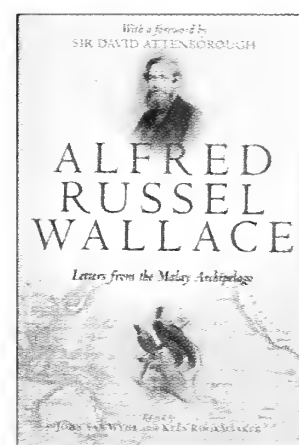
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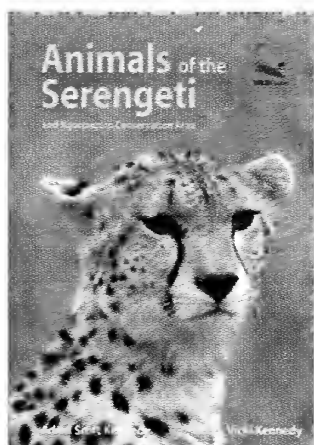
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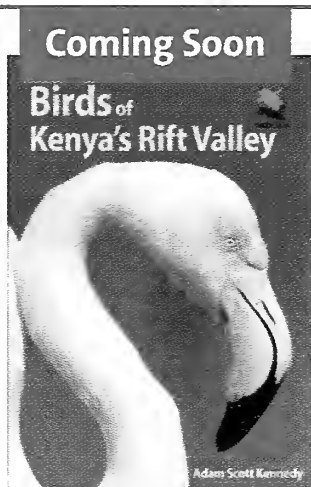
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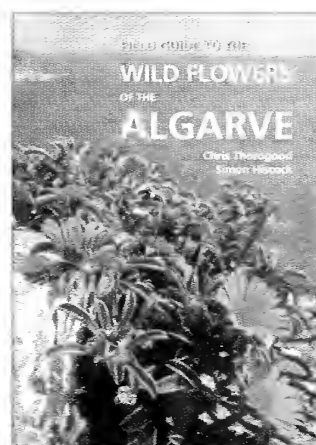


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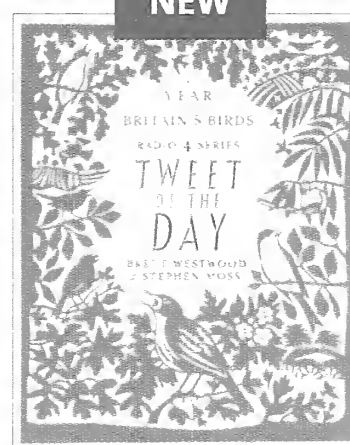


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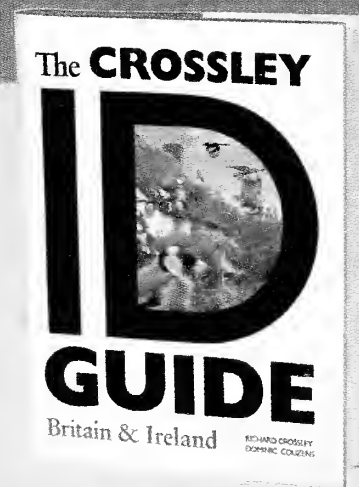
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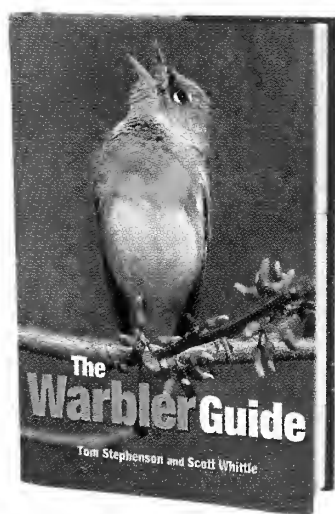
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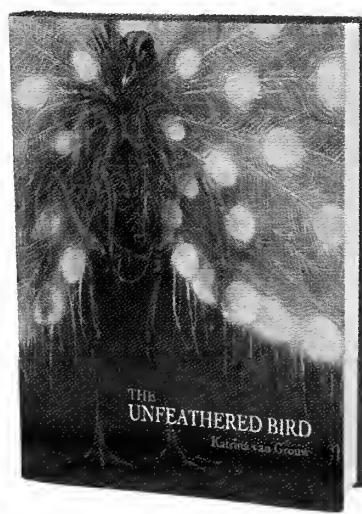
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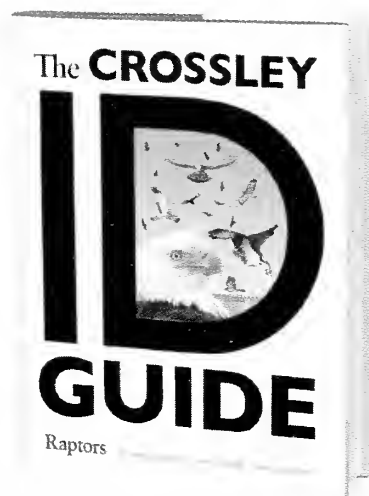
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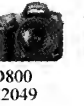
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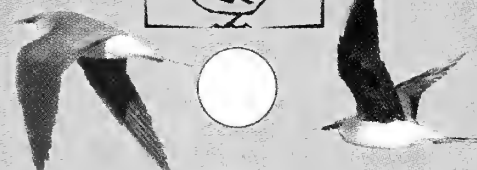
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